

ARTIFICIAL WATERWAYS AND
COMMERCIAL DEVELOPMENT

A. BARTON HEPBURN

CLASS No. 62 7.1 BOOK No. H52a
PROPERTY OF THE
CARNEGIE INSTITUTE OF TECHNOLOGY
LIBRARY
DATE APR 28 1920 ACQ. No. 5741

FORM 236. 2M-1-11.

PROPERTY OF THE
CARNEGIE TECHNICAL SCHOOLS
Department of *Civil Eng.*
Date *3/4/12* No. *8 252*

ARTIFICIAL WATERWAYS AND
COMMERCIAL DEVELOPMENT

(WITH A HISTORY OF THE ERIE CANAL)



THE MACMILLAN COMPANY

NEW YORK • BOSTON • CHICAGO
ATLANTA • SAN FRANCISCO

MACMILLAN & CO., LIMITED

LONDON • BOMBAY • CALCUTTA
MELBOURNE

THE MACMILLAN CO. OF CANADA, LTD.

TORONTO

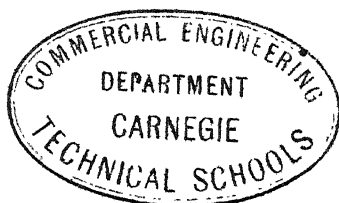
ARTIFICIAL WATERWAYS AND COMMERCIAL DEVELOPMENT

(WITH A HISTORY OF THE ERIE CANAL)

BY

A. BARTON HEPBURN, LL.D., D.C.L.

AUTHOR OF "THE CONTEST FOR SOUND MONEY," ETC.



New York

THE MACMILLAN COMPANY

1909

All rights reserved

COPYRIGHT, 1909,
By THE MACMILLAN COMPANY.

Set up and electrotyped. Published January, 1909.

FOREWORD

THE first improvement upon the slow, tedious, and costly means of transportation by beasts of burden and vehicles was accomplished by utilizing rivers, supplemented by canals, as a thoroughfare for boats and barges.

These waterways determined the routes of commerce until the locomotive engine made land routes the more popular, as they were the more expeditious. Reaching in all directions, spanning waterways, tunneling mountains, and defying obstacles generally, they naturally took command of trade. In almost all other countries, the commercial advantage of maintaining both land and water routes was fully appreciated; in the United States, the impatience of all delay, which characterizes our people in their rush to anticipate the future and bring the latent resources of our phenomenally rich country into soonest possible use, however wasteful such haste may be, found expression in the development and expansion

of railway, and the comparative neglect of canal and river transportation, especially during the last three decades. Denser population with increased local needs, the greater consumption which accompanies the growing wealth of the people, the congestion of traffic generally, and many other causes, are teaching people the unwisdom of neglecting the cheaper, albeit slower, means of transportation.

People have come to realize that the function of artificial water navigation is to supplement and complement, and not to rival, the railways. The great development and successful rivalry of the Canadian canals have attracted wide attention and done much to bring to our people a proper appreciation of the great service which canals and canalized rivers may render.

The failure of New York State to develop and maintain her canal system found yearly expression in the loss of commerce to the city of New York; this manifest fact led to the present great work of enlarging the capacity of her canals. Her canal system is typical, and influences which call for improvement and enlargement in New York will, with equal

force, call for the development of artificial waterways throughout the country. Such development seems to be an imperative need of internal trade.

In order to place before the public in concise form the salient facts as to artificial waterways and their relation to commercial development, this volume has been prepared. As typical of all, the history of the Erie Canal is given, together with a general review of the canal systems of the world.

A. BARTON HEPBURN.

CONTENTS

	PAGE
THE WORLD'S CANALS	I
THE CANAL SYSTEM OF NEW YORK	
I. The Period of Inception	16
II. The Period of Development	33
III. The Present Conditions	49
IV. The Competition against New York City	67
THE PANAMA CANAL	79
THE WATERWAYS QUESTION AND CONSERVATION OF OUR RESOURCES	88
APPENDIX	95
STATISTICAL TABLES	
A. Relating to New York Canals	97
B. Relating to Commerce of New York City	105
C. Miscellaneous	109

ARTIFICIAL WATERWAYS

THE WORLD'S CANALS

THE importance of a well-devised and judiciously located canal system, as a factor in the material development and advance in civilization of a country, is apt to be underestimated by most men, in these days of multiplied railway communication. Prior to the first quarter of the nineteenth century, mankind was dependent upon the tedious and costly transportation by animal power, except where waterways could be made available. Adam Smith, writing, of course, before the era of railways, and having observed the enormous difficulties of traffic over poor highways, in imperfect vehicles, characterized the introduction of artificial waterways very conservatively when he said, in his "Wealth of Nations," that "navigable canals are among the greatest of all improvements."

We find the canal device for supplementing Nature's gifts to man in the way of inland seas and rivers, utilized very early in the history of the race; for even if we regard as perhaps legendary the assertion of Egyptologists that the predecessors of the Pharaohs had created a canal system as far back as 7000 B.C., it is quite certain that the Egyptians, the Chaldeans, and probably also the Chinese, dug artificial waterways many centuries before the beginning of the Christian era. At first these man-made waterways were, doubtless, merely for irrigation purposes; but it was not long before they were utilized to transport surplus products from place to place, connecting natural bodies of water; eventually circumventing the obstacles presented by cataracts; ultimately shortening ocean routes for the largest vessels and converting inland cities into artificial seaports.

Constructive ingenuity must have been developed quite extensively to have made it possible for Nebuchadnezzar to restore the great canal of Babylon, mentioned by Herodotus as one of that ancient city's wonders; originally

cut, as the antiquaries state, about 1700 B.C., that great ruler made it available for merchant vessels in his day (say about 600 B.C.). It would appear that at about this time also there was begun the construction of the predecessor of the present Suez Canal, connecting the Nile and the Mediterranean with the Red Sea, finished later by one of the rulers of Egypt. This waterway is said to have been in use until the ascendancy of the Mohammedans in Egypt; the caliph Al-Mansour is discredited with having ordered its destruction in 767 A.D.

It is a noteworthy fact that those great road and aqueduct builders, the Romans, have left us no important commercial waterways. Marius indeed connected the Rhone with the Mediterranean in Gaul, and Claudius joined the Tiber and the sea; in Britain two dikes are credited to the Roman period; but of these relatively insignificant examples nothing remains at this day; the records show a number of ambitious plans for canals during the reign of the Cæsars, but their wars rendered the practical execution of the enterprises impossible. Thus Europe, with its noble rivers,

remained far behind in the adaptation of the artificial means of increasing their utility. Charlemagne joined the upper Rhine and the Danube, and conceived the plan of connecting the Danube and the Main, probably less for trade purposes than as a means to solidify his empire. The last-named scheme was finally carried into execution in the nineteenth century by Louis I of Bavaria.

China's comprehensive canal building probably began in the seventh century; we are told that her Grand Canal, connecting her capital with the sea at Canton, and branching to other points, finished about the end of the thirteenth century, was 600 years in construction; including canalized rivers, its length exceeds 1000 miles, the longest navigable artificial waterway in the world. Lesser ones, none modern, ramify the entire country, which until very recently had not a mile of railway. The system comprises 5300 miles and has proved indispensable to the existence of that teeming empire; with its aid the great problem of subsisting 400,000,000 human beings was solved; not only are transportation facili-

ties and irrigation provided; the canals supply an abundance of fish, and from their beds is drawn a mass of muck to fertilize the soil.

The beginnings of Europe's great canal systems may be placed somewhere in the twelfth century, and the credit for its practical inauguration belongs to the Dutch, although there are evidences that the British, as early as 1134, and the Italians somewhat later, did some work upon their waterways. The "low countries" were by nature peculiarly adapted for canalization, and to this day they have the greatest mileage of canals compared with area. The aggregate mileage, including the part now known as Belgium, is given as over 3400, the area as 24,000 square miles. This region, together with northeastern France, had by the year 1250 quite a respectable system of waterways.

But the great impulse to canal construction came after the invention of the use of locks, which enabled engineers to overcome the obstacles presented by elevations. This improvement is claimed for both Dutch and Italians; for the latter, at about 1481, for the former

nearly a hundred years earlier. Nevertheless, the prevalence of wars in Europe prevented the extensive development of waterways for more than a century.

Holland's development has probably been the most remarkable ; while most of the works were for inland transport, the magnificent ship canal, by which the port facilities of Amsterdam were, in 1826 and again in 1876, very materially enlarged, stands as one of the most noteworthy engineering feats. More recently the connection of that port and Rotterdam with the lower Rhine merits special notice. Always guarding her commercial interests, once far in advance of the rest of the world, and still, relatively to area and population, occupying front rank, the little kingdom has not hesitated to make great sacrifices temporarily, to attain the objects in view. Thus the 2244 miles of canals are kept in efficient condition, and show a steady increase in utility to her commerce.

Belgium has not maintained her canal system so well, and hence has not shown the extent of traffic increase observable in Hol-

land. The navigable waterways, including rivers and canals, show a mileage of 1360, actively employed.

France began in 1605 the comprehensive system which has added nearly 3000 miles of canals to her natural waterways, at a cost estimated at fully \$750,000,000. The greatest of her many works was the Languedoc, connecting the Mediterranean Sea and the Bay of Biscay, 148 miles, first opened in 1668. This connection was greatly improved in later centuries, the present Canal du Midi, 255 miles, being charged with a total cost exceeding \$100,000,000. But the important fact is that the greater part of this system, now owned by the Government, has been well maintained, and plans therefor, since the opening of the present century, contemplate the application of fully \$100,000,000 in addition. Since 1880 the canals have all been free, toll charges having been abolished during that year. Water traffic has more than doubled since.

Germany had canals connecting some of her great rivers prior to 1700, but the development of the present system was postponed to

modern times. Once undertaken, however, it progressed quickly, energetically, and with great practical results. Nearly every one of her noble streams is connected at commercially strategic points, and no expense has been spared to accomplish the purpose in view. Thus it is reported that in Prussia alone the plans, in 1904, contemplated an outlay of \$80,000,000, following an expense of a nearly equal sum in the twenty years preceding. Not content with the great Kiel Ship Canal (to cut off the rounding of Denmark, by vessels plying between the Baltic and North seas), which cost \$40,000,000, a second and shorter route between these bodies of water, *via* the rivers Elbe and Trave, for smaller craft, was opened in 1900. It is now proposed to enlarge the Kiel Canal or construct a new one with greater capacity. Germany has 1320 miles of canals, with 15,760 miles of navigable rivers; her experiences furnish the best example of the value of waterway development and maintenance in our day. It is, however, to be borne in mind that the entire transport system there is under Government control.

Great Britain's first important work is to be credited to the celebrated Duke of Bridgewater, who in 1757 promoted the connection of Manchester with Liverpool by means of a 38-mile canal; this has in recent years been much enlarged in capacity at a cost of \$75,000,000. The new construction, finished in 1893, gives a minimum depth of 26 feet. A very substantial part of the 2800 miles of canals in the United Kingdom was completed in the eighteenth century; no new inland work of importance has been undertaken since 1834. Nearly 1150 miles of these interior waterways are operated by railway companies, in conjunction with their land traffic; these carry about one seventh of the 42,000,000 tons of freight transported by all canals. In Scotland there are two canals between the North Sea and the Atlantic Ocean, but neither is now of special importance. A project to enlarge one of these into a ship canal, connecting the Firth of Forth with the Clyde, at an expense of about \$38,000,000, has been under consideration. Ireland's Grand Canal, 165 miles long, connecting Dublin with the river

Shannon and other points, is its chief waterway.

Denmark, when it owned Holstein, had a Baltic-North Sea canal, part of which is now used for the new Kiel Ship Canal; otherwise its system is purely local and not extensive.

In Russia, Peter the Great was the first builder of important canals; he began by connecting his capital on the Neva, by way of the Volga, with the Caspian Sea, to reach more expeditiously the caravan trade of southwestern Asia, upon which the Muscovite has for centuries had his eyes. Subsequently connection was made with the ports on the Arctic Ocean; the Black and the Caspian seas and the rivers Dniester and Vistula, were joined, the latter involving 461 miles of canal and river way, said to have cost over \$100,000,000. The recently finished Cronstadt-St. Petersburg Canal cost \$10,000,000, for its six miles of $20\frac{1}{2}$ feet depth. The more ambitious project of making a 27-foot waterway, from the Black Sea to the Baltic, 1000 miles, to cost nearly \$100,000,000, is the latest pro-

posed addition to Russia's means for commercial expansion.

Austria-Hungary's canal system is less heard of, but for her internal trade, connecting all sections with the great Danube, is of transcendent importance. It adds 1700 miles to her 5500 of natural waterways. A project to connect the Danube with the Oder and the Elbe is under consideration.

Sweden began canalization early in the seventeenth century and has maintained a system serving the interests of several interior commercial cities; but the system is chiefly local, her topography not calling for trunk canals.

Italy's 664 miles of canals have likewise only local importance, yet they serve her people well.

The Corinth Ship Canal in Greece is a notable one; only 4 miles in length, it cost \$5,000,000 and saves ships a detour of from 100 to 175 miles. It was opened in 1893.

Spain has, in the matter of canals, as in many other respects, failed to keep abreast of her neighbors. Her long-cherished plan of

joining the Mediterranean Sea and the Bay of Biscay remains in abeyance, being less than half built at the present time. In the reign of Charles II, the Council of Castile opposed canal plans, as an interference with the wisdom of Divine Providence, which had fixed the waterways.

India has the world's longest canal, that of Bengal, 900 miles; there are two others of about 600 and 450 miles respectively; but these are primarily for irrigation purposes; there are many lesser ones employed for transportation.

The Suez Canal, finished in 1869, and costing \$90,000,000, may be characterized as the most important and epoch-making work of its class. It eliminates the long, tedious, and dangerous voyage around the Cape of Good Hope, reducing the route of the valuable Oriental trade one third. It is to be noted, however, that the tonnage passing through it is by no means the largest, aggregating now about 12,000,000 net tons annually.

Although the records indicate that the Peruvians had canals, these were probably irrigation works; certain it is that commercial

canals in the western continent are confined to North America, and practically to the United States and Canada, where numerous noteworthy examples exist. The five great inland seas naturally first attracted attention; their connection with tide water has given the engineering profession abundant opportunity to display their skill, and the more distinctly local undertakings of joining the great rivers with each other and with the great lakes, have employed the energies of all progressive citizens.

In the United States alone, the total mileage of canal works is placed at 4479, of which, however, nearly 2000 miles have been abandoned. The cost, up to 1900, is estimated to have been \$220,000,000. The works of special note are the Erie, in New York State; the Cincinnati and Erie, in Ohio; the Chesapeake and Ohio, and the Sault Ste. Marie, in Michigan. The last named was opened in 1855, and, although less than two miles in length, bears the world's record of vessel tonnage, — 32,000,000 tons in one year.

Canada has also an important canal around St.

Mary's Falls (opened 1895). For the purpose of getting around the Niagara Falls, Canada built the Welland Canal, a very expensive work, but commercially of the first importance. She has many lesser canals, and by means of her system has builded an enormous volume of commerce. It is estimated that Canada has spent fully \$110,000,000 upon artificial waterways, the largest, relative to population and period of construction, on record. We shall presently consider the effect of this policy upon her commerce.

Mulhall, the eminent British statistician, gives the mileage of existing canals and rivers in use, in Europe, at over 77,000, of which 13,293 miles are canals. In the United States the canal mileage is reported as 4479, the mileage of other waterways is 47,355; while Canada has 535 miles of canals and 2820 of rivers, and China 5270 miles of canals and only 3800 of rivers. The total of the world's canals reaches about 26,000 miles; the cost has been in excess of \$2,000,000,000.

It was natural that the advent of railways should interfere, in most countries, with the

development and profitableness of canals. In only a few have the two systems been used jointly and improved equally. The more speedy transit furnished by rail is the chief factor in attracting freight at the expense of the slower canal transportation. This has been specially noticeable in the United States. But the question of cheapening transportation has again come to the fore; expert testimony shows that by means of properly adapted waterways, the charge is at least one third less, and this is accomplished by the expenditure of one thirtieth the hauling power. This fact, and the enormous increase in traffic, have revived interest in the subject of waterways throughout the civilized world. The prices of necessities of life have been enhanced by a multitude of causes, and the world is endeavoring to reduce the part of the cost due to transportation.

THE CANAL SYSTEM OF NEW YORK

I

THE PERIOD OF INCEPTION

THE value, nay the imperative need, of artificial connections between the inland lakes and rivers of the United States and the streams emptying into the Atlantic Ocean, impressed itself upon the far-seeing men of the days before the Revolution, when the migration of the most venturesome of the population toward the West began. Particularly in New York was this the case; for thriving settlements had sprung into existence along the banks of her beautiful rivers. Albany was already a place of considerable importance, and the valley of the Mohawk boasted a number of hamlets. As early as 1724, Cadwalader Colden, Surveyor General, subsequently Lieutenant Governor of the colony, after an exploration of a part of the region, pictured a future

“scene of inland navigation such as cannot be paralleled in any other part of the world.” Gouverneur Morris, as early as 1777, predicted the eventual union of the waters of the Lakes with those of the Hudson and the Atlantic.

George Washington, with the practical appreciation of an engineer and surveyor, began, immediately after the close of the Revolutionary War, to urge the utilization of the unique facilities which Nature had, it would seem, so peculiarly adapted to the purpose in view. Nowhere did the natural barriers presented by the Appalachian range of mountains between the seaboard and the vast territory to the west, so readily offer a way as that to be found in New York State; the Hudson River, carrying tide water through a mountain cleft for a distance of 150 miles; its tributary, the Mohawk, extending westward almost to the smaller lakes, which practically formed a chain to the great inland sea, Ontario, and brought one within comparatively short distance of Erie. These were ideal conditions for canalization.

Washington had familiarized himself with the general topography of the region, by an

exploration undertaken in company with Governor George Clinton and Alexander Hamilton, several years before his election to the Presidency. He thus became an intelligent and persistent advocate of the plans which then began to take shape among the New Yorkers. Washington's view was not wholly the commercial one; to him it was also a question of binding the people of the Nation together for the purpose of perpetuating the Union. If the sturdy pioneers who, out of the narrow Indian trails had hewed roads through the wilderness, planting settlements here and there, but ever farther westward, were to be deprived of adequate means of communication, they would find an outlet by way of the great Mississippi and its tributaries, then in large part in alien hands, with thriving trade centers at St. Louis and other points, and an important port in New Orleans. Thus the country west of the Alleghanies would become a distinct political entity, estranged from the seaboard States. With Washington, as with Charlemagne, artificial waterways represented links in the bond which should hold together the empire.

But the country was poor; a devastating war had left the people struggling to maintain existence; a totally inadequate political system had first to be done away with and a sound constitutional government of united states established. The repudiation of State debts had made it most difficult to borrow money for novel enterprises, and increasing already burdensome taxes was impracticable. As an illustration we have the experience of Christopher Coles, an engineer of note, who had made a survey of the Mohawk Valley in 1784; he submitted plans for the connection of the Hudson River and Lake Ontario, to the New York legislature. He and his associates were tendered the profits of the scheme in perpetuity if they would only carry it out; but he failed to enlist the requisite financial assistance. It is almost pathetic to read that the legislature appropriated the munificent sum of \$125 to enable Coles to complete his surveys.

Another survey, more comprehensive in character, was made in 1791, by direction of the legislature through the efforts of Governor George Clinton. In 1792 two companies were

chartered, one to construct a canal to connect the Hudson River with Lake Champlain, which, however, "fell by the wayside"; the other, the "Western Inland Navigation Company," to connect the Hudson and Lake Ontario. The State took 200 shares of the \$25 stock of the company and loaned it £15,000 on mortgage, for which it later also took stock. With this support something was actually accomplished; by the end of 1796 the company had six miles of canal at and about Little Falls, navigable by 16-ton vessels, to facilitate the use of the upper Mohawk; the work cost \$400,000. Soon thereafter connection was made between the Oswego River (flowing into Lake Ontario) and Cayuga and Seneca lakes. This initial canal work was done by William Weston, afterwards Superintendent of Canals. Among the most earnest supporters were Thomas Eddy, the philanthropist and Stephen Van Rensselaer, the patroon. These men saw in the project for the Erie waterway a means by which New York City would obtain the commerce of the great West "forever" without need of fearing rivalry; the

City would thereby become "the greatest commercial emporium of the world, excepting, eventually perhaps, New Orleans or some other depot at the mouth of the majestic Mississippi." The thought that anything could ever supersede water transportation was evidently far from their minds.

Notwithstanding all the arguments and discussions and the obvious interest of the State, notwithstanding the enormous cost of transportation, estimated to have been \$100 per ton from Buffalo to New York, many years were to pass before anything further was done toward a canal system. The people who were building up the central and western parts of the State felt the need of better transit facilities. Ohio was coming into prominence as a producing territory and a commercial field, soon (in 1803) to become one of the sisterhood of States. Indiana, Michigan, Illinois, and Wisconsin were now the outer territories, but rapidly growing. Here was an empire to be exploited commercially. But the people of New York City and the southern end of the State, to whom the benefits to accrue,

naturally perhaps, appeared more remote, were for a long time only mildly affected by the agitation. The enthusiasm of Gouverneur Morris, who told them among other things that he foresaw the time when ships would "sail from London through the Hudson River to Lake Erie" by a splendid canal, failed to impress them sufficiently. This patriotic citizen, then a Senator in Congress, was joined by De Witt Clinton, whose name is associated with New York's canal system for all time. It was uphill work; the support of the people of the lower end of the State was necessary, and the influence of the opposition, the "bourbons" of the period, among whom were the leading "sachems" of the Tammany Hall of that day, was difficult to overcome. The expense of the enterprise, a present bugaboo, overshadowed the prospect of much greater future benefits.

A traveler of the period has left us an interesting record of the difficulties of transit prevailing; it took from two to five days to reach Albany from New York, by river; thence overland to Schenectady, 17 miles, to the navigable part of the Mohawk River; to Utica,

104 miles, by sailboats, with auxiliary swing-oars and poles to be used in case of a calm; these made 18 to 20 miles per day, consuming the better part of a week; to Oswego, 114 miles further, took another nine days. On the Hudson River freight rates averaged 40 cents per hundredweight; the small canals already referred to, charged \$2.25 to \$3 per ton. On the Mohawk the rate was 75 cents per hundredweight to Utica and \$1.25 on the western section from Utica to Oswego, making a total of about \$50 per ton from New York to Oswego. There was much dissatisfaction at the charges imposed by the canal company, and comparatively large quantities of freight were taken overland in that section, owing to the exorbitant rates.

Robert Fulton's successful demonstration of his steamboat in 1807, by means of which the transit time to Albany was soon reduced to 30 hours, tended to increase the dissatisfaction of the people "up-State" with existing conditions. Clinton was quick to seize upon this as a lever to influence public opinion. At this time, also, President Jefferson's plan to

spend the accumulated Federal surplus (then approximating \$10,000,000) in the construction of roads and canals, a project which had the full approval of Albert Gallatin and the other broad-gauge members of the Jefferson party, gave New Yorkers hope that they would receive support from the National Government. In 1808 the New York legislature, at the behest of Joshua Forman of Onondaga, and Thomas R. Gold of Oneida, appointed a committee to consider plans for a canal to Lake Erie, with a view to obtaining aid from Congress by an appropriation to accomplish "that great national object." It was declared that "while this State would forbear to derogate from the claims of others, she felt warranted in presenting to the Government of the Union her own territory as preëminently distinguished for commercial advantage."

Simeon De Witt, the Surveyor General, was directed to cause the route suggested to be accurately surveyed, and the sum of six hundred dollars (\$600 !) was appropriated by the legislature for the purpose. The survey demonstrated the complete availability of the

route which was later adopted. De Witt, who was appointed Surveyor General in 1784, held that office continuously for fifty years, covering thus the entire period of the conception, birth, and first growth of the canal system, to the promotion of which he gave his life service.

It was not until 1810, however, that a Canal Commission was actually provided for by the legislature; it included besides Morris, Clinton, and De Witt, William North, Thomas Eddy, and Peter B. Porter. In 1811 Robert Fulton and Robert R. Livingston were added. A thorough exploration at this time produced an estimate of cost of a canal to Lake Erie at \$5,000,000. Morris and Clinton were sent to Washington to endeavor to obtain support from the Federal Government, but President Madison was not favorable to the use of public money for this purpose, and the committee returned to New York disappointed.

The scope of the canal enterprise was rightly considered national in character. While Madison and Monroe were solicitous that the canal be built, as strict construction-

ists they believed that no aid could be extended without first amending the Federal Constitution. Gouverneur Morris urged that the Federal Government should build the canal and its operation and control should be regulated by "treaty" between the State and Nation. In this proposition we see the then conception of "State sovereignty," and how lightly the bonds of union were regarded; and also observe that the question of the regulation of interstate commerce was early brought into prominence. The "general welfare" clause of the organic law had not yet been elaborated.

The War of 1812, with its burdens and responsibilities, eliminated the Federal Government as a possible builder of the canal.

The agitation was continued throughout the State, especially by Clinton, after his defeat for the Presidency; and in June, 1812, the legislature passed an act authorizing the Canal Commission to borrow money and accept grants of land preparatory to the beginning of work. But borrowing money during the war was out of the question, and the progress of the enterprise halted. In 1816, Governor

Tompkins strongly urged that the State proceed to build the canal without further delay. A new Commission was created with Clinton at its head, further surveys were made, and more elaborate estimates of costs prepared, which included connection with Lake Champlain as well as with Lake Erie. The width of the canal was to be 40 feet at surface, 28 feet at bottom, and the depth 4 feet. The estimate of cost was \$5,442,813. On April 15, 1817, the legislature terminated the long speculation by actually authorizing the construction of the canal, creating a Canal Board consisting of all the executive State officers except the Governor, which was given power to borrow money on the credit of the State. The canal fund created was to be under their charge. The Clinton Commission was continued, charged with the duty of construction, operation, and maintenance. This division of authority soon caused difficulties which resulted in vesting the power of both in a differently constituted board, created in 1826.

The patronage of the canal appealed to the selfishness of men and involved in its con-

struction the vicissitudes of party politics, engendering the fiercest political and personal animosities. Clinton was not above using the patronage to regain and promote his political prestige, but above all things he devoted his energies to the success of the canal. He boldly made it the issue in the gubernatorial campaign of 1817; he compelled his nomination for the Governorship and defeated his opponent, Peter B. Porter, one of his colleagues on the Canal Commission of 1810, by the decisive total of 43,310 votes against 14,799, a most extraordinary expression of public opinion and confidence.

His inauguration took place on July 1, 1817, and three days later, on the Nation's chief holiday, he had the supreme satisfaction of breaking ground for the canal at Rome, then a promising village on the Mohawk River (formerly Fort Stanwix), amid great ceremony and jubilation. Thus, after thirty years from the date when his uncle, George Clinton, had urged the matter on the people, they finally, under the leadership of the nephew of the first Governor, seriously began work. The

little canals of the Western Inland Navigation Company, already referred to, were bought for \$152,718; extension was pushed vigorously, and by October, 1819, the section between Rome and Utica, 15 miles, was open to navigation. In November of the same year boats from the Hudson River passed into Lake Champlain; in 1820 the Erie reached the Seneca River, and it was confidently reported that it would be completed by 1823. In this Clinton was, however, disappointed, and his opponents made the most of the delay.

The control of the, for that day, vast patronage of the canal, intensified political rancor and gave to politics a vehemence and virulence unprecedented. Clinton was charged with everything from bankrupting the State to plotting secession of New York from the Union. Although reëlected Governor in 1820, over Tompkins, who now opposed the canal, his majority was so slender and his hold upon the people so precarious during the second term, that he was compelled to retire from the contest for a third nomination in 1822. In April, 1824, he was removed from

the position of Canal Commissioner, which he had held continuously from the creation of the original Commission in 1810, even while Governor. This humiliation, believed at the time to be his political deathblow, was accomplished by the overwhelming vote of the legislature, dominated by Van Buren, William L. Marcy, Silas Wright, and their associates, who had now become all-powerful as the "Albany Regency."

But, after all, the people wanted the canal; the new régime was not apparently making satisfactory progress. Clinton took advantage of the situation, accepted a nomination for the Governorship in 1824, and in the fall of that year, scarcely six months after his humiliation, he was elected by a vote of 103,452 against 87,093. With Clinton again in the harness, the canal work progressed at a lively pace; and again he experienced the satisfaction of presiding over the destinies of the State officially when, on October 26, 1825, the first boat to make the trip through the finished Erie Canal left Buffalo, with the Governor, Stephen Van Rensselaer, Joshua Forman,

Chancellor Livingston, William L. Stone, and Thurlow Weed among those on board; conspicuous by their absence were the members of the Albany Regency.

The trip of the "Seneca Chief," as the canal boat was named, was probably the most thoroughly celebrated event New York State has ever experienced. All along the route was a jubilant people, making it a continuous holiday parade; ringing of bells and booming of cannon greeted it everywhere; and Clinton was the hero of the fortnight. On November 4, the boat, escorted from Albany by a fleet of steamers, arrived in New York City, where civic, military, and naval parades followed, accompanied by the most extravagant demonstrations of popular enthusiasm. A memorial medal was struck by the municipal authorities, the face of which was subsequently adopted as the seal of the Canal Department. Two kegs of water from Lake Erie had been brought along, and one of these was taken to Sandy Hook and the water ceremoniously poured into the Atlantic Ocean,—to render realistic one of the prophecies of Gouverneur Morris, who

had in the meantime passed away; the contents of the other keg were bottled as mementos, and one of these bottles was presented to Lafayette, who had a short time before been the guest of the City. An enthusiastic citizen had procured bottles of water from the Nile, the Ganges, the Indus, the Thames, the Seine, the Rhine, the Mississippi, the Columbia, the Orinoco, and the La Plata, all of which were also, with proper ceremony, emptied into the Atlantic, after those of the Erie had been mingled with its brine. This mingling of waters typified the ambitious faith of the builders that the commerce of the canal system was bound to commingle with and be enlarged by the commerce of all portions of the world.

The festivities lasted until the night of November 7, concluding with a grand ball. It is recorded that the news of the opening of the Grand Canal, as it was called for many years, was sent from Buffalo to Sandy Hook, over 500 miles, in 81 minutes, by means of booming cannon placed at proper distances along the line. Our forbears, rejoicing over this great achievement in transportation,

sought to hasten the news of the canal's opening by booming cannon as fast as sound travels. They little dreamed that in less than a century Buffalo and New York would converse with the same ease and certainty as persons seated face to face.

II

THE PERIOD OF DEVELOPMENT

Thus "Clinton's Ditch," as his opponents in politics contemptuously called it, was a fixed fact, notwithstanding ex-Governor (then Vice President) Tompkins's declaration a short time before, that it was a "chimerical project." There were not a few men of prominence who still regarded it as a public work undertaken many years too soon. Its cost had exceeded the estimates; for when, after some years, the "finishing touches" had been actually completed, the total amounted to \$7,143,789, or over \$2,000,000 more than the highest anterior estimate. But it began to yield revenue before its completion, and in fact had turned into the treasury more in tolls than the actual

cost, before that account was closed in 1836, thus justifying the faith of its advocates in a much greater measure than even they had anticipated.

In 1826 Clinton was elected Governor for the fourth time, and died in office in 1828. Few, if any, men have, within the borders of a single State of our Union, achieved as great a work as fell to De Witt Clinton; few have perhaps had opportunities equal to those which came his way; but after all, it was his genius and constant devotion to the purpose in view, that led him to seize these opportunities and make the most of them, despite rather tactless political methods which occasionally created obstacles. Few men in public life suffered such violent and factious opposition, and overcame them by forcing upon the minds of the people the measures which would best serve them. It cannot be said that his labors were ignored, for he was given high station; but it nevertheless remained for the future to fully appreciate the great merits of his efforts for the general welfare. Not the least of the testimonials to his achievements is the statue

which adorns the most prominent place in the front of the magnificent home of the Chamber of Commerce in the City of New York.

The canal system thus completed, near the end of 1825, included only the Erie and the Champlain; the former, 352 miles in length with 9 miles of adjuncts, the latter 81 miles, including feeders. Together they had cost the State the sum of \$9,048,963; and to the end of 1837 additional construction work found necessary cost \$928,981 more, giving a total during this first period of nearly \$10,000,000. Beginning with the modest revenue of \$5436 in 1821, the tolls produced annually increasing sums, the total for 1825 being \$566,112; by 1830 the \$1,000,000 mark was passed, and the total revenues to the end of 1837 aggregated over \$15,000,000, thus more than repaying the original outlay, after providing for operating expenses. No reports of tonnage carried were made in the earlier years, but judging by the tolls the quantity must have reached over 1,000,000 tons annually for several years before 1836, when a tonnage of 1,310,000 is recorded.

Freight payments for the period ending with 1837 also exceeded a total of \$15,000,000. Rates were reduced very largely; the charge from Buffalo to Albany was still \$22 in 1824; in 1835 it was down to about \$4. The promised diversion of traffic to New York was being realized; the signal success of the undertaking led to other similar projects, which the people for a time gladly favored. In 1825 work was begun on a canal 38 miles long, connecting the Erie with Lake Ontario at Oswego, and also on the Cayuga and Seneca, 23 miles in length; in 1830 the Chemung, in 1831 the Crooked Lake, in 1833 the Chenango, and in 1837 the Black River and Genesee Valley canals were begun; in the following decade lesser works were provided for, making in all a system of artificial waterways over 960 miles in length. State aid to the amount of \$800,000 was also extended to the Delaware and Hudson Company, which had a canal 108 miles long, partly in Pennsylvania, which was abandoned in 1898.

It soon became obvious that the carrying capacity of the Erie Canal was not equal to the

commercial demands. It could only float boats not exceeding 80 feet long by 15 feet wide and $3\frac{1}{2}$ feet draught, the maximum burthen being 75 tons. The employment of larger vessels would enable the State to reap greater advantage from the enormous trade which was now rapidly developing in the West and Northwest; the agitation for enlargement became sufficiently strong to induce the legislature, by an Act of May 11, 1835, to authorize this work, so as to accommodate vessels of 200 tons, and by 1837 it was being vigorously pushed. The estimate of cost of enlargement varied as the work progressed, ranging from \$12,500,000 to \$30,000,000. This was an unprecedented sum to be placed under the control of any party administration. The Albany Regency, then all-powerful, had adopted the political tenet of Marcy, "To the victors belong the spoils." Extravagance and waste were clearly shown to have governed in the execution of the work, and coming as it did immediately after the paralyzing crisis of 1837, it seemed for a time as if the credit of the State would be seriously compromised. It was impossible to promptly

pay the cost of the work, and it was therefore suspended by order of the legislature, but not until the expenditure had exceeded \$12,000,000 without having produced practical results. Suspension of work added to the waste which bad management and extravagance had caused. What may, perhaps, be regarded as a much greater evil than this money loss, was the serious lowering of political morals engendered by the lavish disbursement of public money shown by a legislative investigation in 1846. The "canal ring" was born, and what has since been concisely termed "graft," fastened itself upon the body politic so firmly, that for two generations every endeavor to do anything for the canal system has encountered distrust and hesitation. The people are compelled to be on guard against the insidious influences of the plunder that the business offers to unscrupulous jobbers and politicians.

During this period another factor affecting the future of the canals first became manifest; steam railroad transportation had been invented. In 1831, the first line, the Mohawk and Hudson Railroad, was opened from Albany

to Schenectady, a distance of 17 miles. The Erie Railway was projected, and in 1836 received State aid (for the benefit of the "southern tier counties") to the amount of \$3,000,000. The company failed in the troublesome years after 1837, and only part of the line from Piermont westward was ready for use in 1841, by which time Albany and Buffalo had been connected by rail. In the same year the Hudson River Railroad from New York to Albany was completed, thus giving a primitive sort of through rail line from the lakes to the seaboard. The Erie finally reached Buffalo in 1851.

The record of operations of the canals from 1838 to 1847 showed no effect from railway competition. They had transferred in the decade 17,300,000 tons of freight valued at \$893,000,000, of which more than half—9,500,000 tons,—of the value of \$348,000,000, was freight carried through to New York City. The State received in tolls \$22,200,000 (a general average of \$1.28 per ton carried), and freighters collected \$22,600,000 (an average, without regard to distance, of \$1.30½ per ton).

The actual rate for down freight from Buffalo to Albany fell as low as \$2.65; tolls were \$3.28; up freight, always higher, ranged from \$9.53 to \$5, and tolls were \$6.57 per ton. The time required for the transit of through freight was 10 days; passengers going by light, swift "packet" boats made the trip in $3\frac{1}{2}$ days.

In 1846 there was a revision of the constitution of the State, in which the canals received considerable attention. A better system of control was provided for, a definite sinking fund to pay off the canal debt was established, and a portion of the revenues from tolls was to be applied for current State purposes. A general provision prohibited incurring debts in excess of \$1,000,000, without the people's consent, and bonds issued were to be repayable in eighteen years. The constitution also forbade the sale of any of the canals for all time. There was an adjustment of accounts between the State and the canals up to that date, which shows that the general revenues of the State had contributed \$7,924,520 to the canals, including \$320,518 derived

from sales of lands, partly those donated to the canals; there had been repaid the State on this account \$2,537,603, leaving a balance of \$5,386,917. This represented the net investment in the canals by the State, in 1846. The specific canal debt was at this time slightly under \$17,000,000.

The agitation for enlargement of the canal was resumed, and with the feeling that the constitutional provisions rendered it reasonably safe to make the great expenditures required, without waste, the assent of the legislature was given. By 1849 it was possible to put into use vessels of 100 tons burthen, and by 1853, after an expenditure of about \$5,000,000, vessels of 200 tons were actually in use on the Erie. But results were coming too slowly; accordingly in 1854 there was submitted to the people a plan under which larger debts could be incurred for canal purposes, and the people voted by 185,771 to 60,526 to expedite the work. In the six years following over \$12,500,000 was spent in construction, and by 1862 the work of enlargement was considered complete. Thus, after 27 years of agitation

and a total expense of over \$33,000,000, the Erie Canal was 70 feet wide at surface, 52 feet at bottom, and 7 feet deep, enabling vessels with 6 feet draught, of a tonnage of 240 tons, to navigate it conveniently. This increase of capacity meant a maximum boat load of 8000 bushels of wheat, compared with 1000 bushels in the primitive stage and 2500 bushels from 1830 to 1850. The money spent was not all borrowed; the canal revenues helped very largely to meet the expenditures. Thus, to the end of 1862, the total cost of construction and enlargement for the whole system aggregated \$61,000,000; the enlargement of the Erie had cost \$33,000,000; the Erie and Champlain had cost prior thereto about \$10,000,000, and the lesser works \$18,000,000. The canal debt reached its maximum in 1860, when the amount outstanding was \$27,107,000, or about \$20,000,000 more than it was at the beginning of 1835, when enlargement work began. The net revenues of the system had been in excess of \$73,000,000, and the direct payments by the State for canals had been exceeded by the amounts contributed

from tolls to the general State funds under the constitutional provision of 1846,—some \$8,500,000. During the period from 1846 to 1862 the redemptions of debt (paying off the old bonds as they matured) amounted to about \$25,000,000, and the new issues were \$28,000,000. It would appear, therefore, that the canals paid fully \$13,000,000 of the sum spent for enlargement. It should be stated that a rapid reduction of the debt took place after construction expenses ceased; thus by 1867 the debt was only \$15,700,000; by 1869 it was down to \$12,000,000; thereafter liquidation was slower, as the bonds had not matured.

The effect of the enlargement of the canal was immediately shown in the increase of business; for in the decade from 1848 to 1857 the total freight carried was 36,100,000 tons, considerably more than double the quantity transferred in the preceding ten-year period; the value of the freight rose in even greater ratio, making a total of \$1,765,000,000. Of this total \$624,000,000 of values, represented by 20,600,000 tons, was tide water freight,

carried down to New York City. The State received \$29,800,000 in tolls, although the rates had been lowered; the average per ton was $82\frac{1}{2}\phi$. Freight charges yielded the boat owners \$30,300,000, thus giving an average per ton slightly higher than the tolls (nearly 84ϕ), but nevertheless $46\frac{1}{2}\phi$ per ton less than in the previous decade. Actual charges for down freight had fallen to \$2.67 in 1857; for transfer the other way (from Albany to Buffalo) the rate was as low as \$2.13 per ton. The cost of maintenance and operation of the canals increased with the enlargement, in some respects out of proportion; in 1847 the ratio was 18.52 % of the revenue; during the decade under review it averaged 30.52 %, having been as high as 41.51 % in 1854. It was in the last-named year that the legislature provided for a "contract board" which had charge of the entire subject of new work and repairs. The result was at first fairly satisfactory, but there were, as we shall see later, serious criticisms, fully warranted, against this system, when laxity of supervision intervened.

A number of factors affected the business of the canals in the decade following 1857; the consequence of the financial crisis of that year was one of the untoward elements; the active competition of railways, now first seriously felt, was another. The effects of these conditions were reflected in the diminished traffic, and the freighters clamored for a further reduction of tolls, which was accorded. Upon the other hand, after 1860, the Civil War closed operations *via* the Mississippi River, and such an abundance of freight was offered that the canals did not fail to benefit very largely by the circumstance, as well as the railways. Thus the total carriage of freight by canals in this decade reached 48,800,000 tons, valued at \$2,095,000,000, of which 27,400,000 tons was through freight, somewhat less in proportion than formerly. The value of the latter was \$1,011,000,000. The State received an average of nearly 76¢ per ton in tolls, in all \$37,000,000, and freighters were paid \$45,900,000, being about 94¢ per ton,—quite an increase over the average rate in the preceding decade, partly due to

the reduction of tolls. The charge from Buffalo to Albany, at first down to \$2.03, ranged during the latter part of the period about \$2.50 per ton; from Albany to Buffalo the rail competition was seriously felt; return cargoes were taken in the earlier years at a rate as low as \$1.21, and rose only to about \$1.50 per ton. The maintenance and operation cost was again about 30%.

Statistics relating to railway traffic are available for this and subsequent periods. The total freight carried by the New York Central and Erie railways, and the ton mileage of the railways and canals, are shown in the following comparative table:—

Years	Railways Tons	Per Cent of Total	Ton Mileage		Per Cent by Rail
			Railways	Canals and River	
1853-1857	7,700,000	27.9	1,344,000,000	4,617,000,000	22.5
1858-1862	12,500,000	36.0	2,353,000,000	5,899,000,000	28.5
1863-1867	23,200,000	46.6	4,156,000,000	6,839,000,000	37.8

Other railway companies were also entering the field and becoming important competitors. It would appear, therefore, that the railways profited very largely from the closure, by the

Civil War, of southern outlets for the commerce of the Western States. The canals also benefited, but there were clear indications that the land lines were gaining in greater proportion. There was still an advantage on the side of the canals in the lower classes of freight for the long-haul, as shown by the ton-mile returns, but this advantage was destined also to be lost to them later, particularly after the New York Central and the Hudson River railroads were consolidated in 1869. This was obviously the time for the friends of the canal system to demand further improvements.

Another constitutional convention was held in the year 1867, and much attention given to the canals. But the convention recommendations in general were upon partisan lines, and were emphatically rejected by the popular vote. The discussion gives us some interesting information. Thus, while it was well known that the canals had been yielding handsome revenues, nevertheless the debt and the interest thereon were considered a burden. Were interest payments also reckoned, claimed the short-sighted ones, the canal system would be

shown to have been very costly. In response data were furnished showing the total cost to 1867, with interest thereon at 7%, the legal rate at the time; the expense for operation, maintenance, and repairs, likewise with interest, and, upon the other hand, the total revenues and the interest which these might have earned at the same rate; with the result showing that the State had given less than \$7,500,000 more than it received. The figures follow:—

Cost of construction	
and improvement	\$ 64,710,837; interest thereon
	\$ 93,736,655
Cost of operation,	
maintenance, and	
repairs	<u>24,377,114; interest thereon</u>
	<u>27,268,895</u>
Total outgo . .	\$ 89,087,951; interest thereon
	\$ 121,005,550
Aggregate cost, with interest thereon	\$ 210,093,502
Revenues received, with interest thereon	202,619,510
Apparent excess of cost	<u>\$ 7,473,992</u>

It was further shown that Erie and Champlain canals had a credit balance of \$38,455,560 upon this basis, and that the others produced a debit balance of \$45,965,940.

The "plant" of the system had thus cost actually less than \$65,000,000; but the railways of the State had, up to 1850, invested in construction and equipment fully \$60,000,000; by

1860 this sum had been doubled; by 1870 practically quadrupled. The canals had for some years been receiving annually less than \$1,000,000 for construction and repairs, whereas the railways were adopting every means offered to increase their efficiency, to enlarge their hauling capacity, to reduce the cost of the service. Thus real competition soon became out of the question.

III

THE PRESENT CONDITIONS

The blindness to their own interests on the part of the people, by neglecting the canals, was due chiefly to the lack of adequate leadership among the public men; the railway interests were doubtless influential in preventing the State from keeping the canals in a proper state of efficiency. This apathetic condition continued, and nothing of real consequence was done until after the beginning of the twentieth century; only ineffectual attempts to provide remedies were made in the interval.

Yet there are some matters worthy of record occurring during the decade from 1868 to 1877. The contract system of doing the canal work was thoroughly overhauled; a legislative committee of 1867 confirmed the general belief that the operations of the "canal ring" had caused great waste; a canal convention in 1870 denounced the practices under the system in no uncertain language, demanding the prosecution of all persons who had fraudulently obtained public money thereunder. But there prevailed an era of general extravagance and plundering of the State treasury; and the ringleaders were so firmly intrenched in power that they defied all ordinary attacks. The notorious Tweed was one of the chief characters in the lower ranks of the new Albany Regency; Governor Hoffman did not escape censure for his inability or unwillingness to break the ring. Under his successor, Governor Dix, some efforts were made in that direction; a State commission was appointed to suggest remedies, and some prosecutions were begun; but it was left to Samuel J. Tilden, who became Governor in 1875, to put

the wheels in motion energetically. He had investigated and thoroughly mastered existing conditions, and devoted his great ability and all the influence of his office to uprooting the evils and safeguarding the future. Many officials lost their positions, many were pilloried before the public judgment and suffered lasting disgrace; but few criminals were convicted, and none of the public money diverted was recovered, so wide were the ramifications of the "ring," and so great its power. To illustrate the extravagance, the record showed, for the five years ending 1874, an expenditure for operation and maintenance of the canals, exclusive of "extra repairs," of \$9,202,000 out of \$15,058,000 receipts,—or more than 61 %.

In 1874, coincidently with Tilden's election, the people adopted a constitutional amendment prohibiting the use of the sinking funds for any other purposes than those of extinguishing the debts (they had been trenched upon by the extravagance); claims against the State were to be barred by limitation, just as ordinary claims are. The purpose

was to more closely scrutinize the entire canal business.

In the government of New York City, as well as in various departments of the State government, boards and commissions had been tried with unsatisfactory results. The people came to believe that in order to concentrate responsibility, it is necessary to concentrate power. Divided responsibility permitted derelict public officials to escape punishment, and the policy of placing departments under the control of a single responsible head was inaugurated. Accordingly, in 1876, another constitutional amendment provided for a Superintendent of Public Works in the place of the "contract board" and canal commissioners. This officer was charged with the supervision of navigation and repairs and was a member of the Canal Board. In order to make it more impressive, apparently, the prohibition against sales of the canal property was repeated in the amendment. It was, however, deemed judicious to abandon some of the canals which had proved too expensive; after 1878 the only ones operated were the Erie, Champlain, Oswego, Cayuga and

Seneca, and Black River. Notwithstanding untoward conditions the business of the canals for the decade 1868-1877 proved the largest in their history, freight carried having aggregated 57,700,000 tons, valued at \$2,032,000,000, showing a decline in average values. Of this fully 31,200,000 tons, of the value of \$1,047,000,000, was downward tide water freight. But the railways carried over 104,000,000 tons during the period, showing that relatively the canals were losing ground. Tolls had again been lowered after the financial crisis of 1873, and hence aggregated only \$26,200,000, an average of 44.5¢ per ton; freight rates were well maintained, the average per ton being 86¢ and the total paid \$50,200,000; the down-freight rate (Buffalo to Albany) fell as low as \$1.52 at the end of the period, and up freight was only 3¢ per ton higher. The result of the railway competition in the latter half of the decade placed their ton mileage far ahead of that of the canals, so that for the period the figures were 19,576,000,000 ton miles for the New York Central and Erie lines, against 13,680,000,000 for water lines, a ratio 58.8% for the railways, compared

with 33.8% in the previous decade. A number of devices to increase facilities on the canals were experimented with at this time, particularly steam towage, but without practical results.

The decline of the canal business actually began in 1874 and despite the lowering of tolls. The record year for tonnage was 1872, when 6,673,570 tons were moved; the record year for values was 1868, when a total of \$305,301,920 was reached.

A movement was now inaugurated to abolish all tolls, and so popular did it prove that the legislature submitted a constitutional amendment for this purpose to the people in November, 1882. It was adopted by a vote of 486,106 against 163,151. This measure provided that the expenses of operation and maintenance be borne by the general revenues of the State, and authorized borrowing to cover deficiencies.

When tolls were abolished and the maintenance of the New York canal system made a charge upon the taxpayers, the natural impulse toward economy on the part of all, plus the

selfish but shortsighted policy of opposition on the part of localities not adjacent to the canals, reënforced by the opposition from competing railways ably and shrewdly administered by railway managers, rendered the future of the canals most precarious. Their proper maintenance was jeopardized by meager appropriations and all enlargement of capacity rendered impossible save by constitutional amendment. An object lesson was required to teach the public that the canals, in their then condition, hedged in and crippled by restrictive constitutional provisions, must inevitably sink into decay; that they could not compete with the railways and serve the commercial interests of the State unless they kept abreast of the times, enlarged their capacity, and adopted modern improvements, the same as their competitors were doing. Experiences following 1882 led many good friends of the canals to question the wisdom of abolishing the tolls.

There was at this time substantially no State debt excepting the canal bonds amounting to about \$9,000,000. The financial results

of the entire system to the end of 1882 were as follows :—

Total revenues of the canals	\$ 135,418,325
Expense of operation and maintenance	<u>48,399,287</u>
Net revenues	\$ 87,019,038
Cost of construction and improvement	<u>78,685,580</u>
Profit without considering interest	\$ 8,333,458

But the loss on the canals that had been abandoned was over \$18,600,000, so that the existing system had to its credit a gain of nearly \$27,000,000. The interest payments, of course, largely overbalanced this profit; about \$48,000,000 of the cost of "plant" had been borrowed; the rest came from the canal and general revenues. The canals had paid back to the general funds \$18,850,000; but the Erie had paid the State \$42,599,718 more than the face of the cost, and, in fact, a large surplus above the cost with interest on the debt incurred.

The canals had carried nearly 200,000,000 tons of freight in the 60 years of their operation; the value thereof was \$8,326,000,000. Contrast this with the modest prediction of the canal commissioners of 1812, that the sys-

tem might develop a trade of 250,000 tons a year! Freights brought to the boat owners \$182,500,000, thus making a total of tolls and freight of nearly \$318,000,000. These figures represent only a fraction of the benefits derived. The State grew enormously in wealth as well as in population; in 1817 the assessed valuation was \$299,000,000; it had more than doubled by 1837; again doubled by 1853, when the returns showed \$1,266,000,000. This was again doubled by 1876, and in 1882 the amount stood at \$2,800,000,000, of which the "canal counties" returned over 75%. The greater part of the early growth and much of the later was unquestionably due to the existence of the canals.

Abolition of tolls did not check the falling off of business; during the five years ending 1882, the average annual tonnage was 5,500,000, valued at \$205,000,000, of which 3,400,000 tons was downward tide water freight, valued at \$92,000,000. In the decade following 1882, the average fell to slightly over 5,000,000 tons, valued at \$146,600,000. The quantity of freight carried down to New York City averaged

2,800,000 tons, the value thereof \$64,000,000; the two principal competing railways were carrying an average of over 34,000,000 tons annually, and other lines were taking more than the canals. That the question of State tolls was not an important factor was conclusively shown. There was an evident desire for a speedier service, notwithstanding the higher cost.

The friends of the canals were not inactive; upon several occasions efforts were made to improve the conditions, notably in the legislative session of 1891, when a plan was formulated. This met with defeat, which brought about a convention of delegates from chambers of commerce and boards of trade in October, 1892, at which the whole subject was fully discussed and the legislature addressed in eloquent terms, setting forth the enormous advantage of the waterways to the State, the menace to the commerce of the State involved in the continuance of the prevailing policy and the urgency of immediate action. A commission was appointed to consider the subject seriously, and it reported favorably for the improvement, but confining itself to rather

narrow lines. After long discussions and much opposition, in no small degree instigated by railway interests, the legislature passed a measure providing for the deepening of the Erie and Oswego canals to 9 feet and the Champlain to 7 feet, at an expense estimated at \$9,000,000, to provide which so much as might be necessary was to be borrowed by means of 3% bonds. This work was expected to increase the capacity of canal boats one third. In order, presumably, to protect the boat interests and prevent the canal from falling under the control of the railways, an act was passed in 1896 prohibiting corporations formed to navigate the canals from being capitalized in excess of \$50,000.

The most far-sighted advocates of canal improvement felt that the plan of 1895 was merely trifling with the subject; that it was a "penny-wise and pound-foolish" policy;—and so it proved. Not only was all the money, of which \$8,500,000 was borrowed, spent without bringing the expected results, but the State had again to experience scandalous practices in the mode of expenditures. It may

be said, however, for the sake of the canals, "It's an ill wind that blows no one good"; the denouement of this failure served to fix public attention more generally upon the value of the waterways, and more of the citizens of the State gave it intelligent consideration. Successive commissions of experts were appointed, elaborate surveys made, and most elaborate and complete data obtained. Various plans were formulated and earnestly advocated, and finally a plan of enlargement, estimated to cost \$101,000,000, which would enable 1000-ton vessels to navigate the Erie, and materially enlarge the Champlain, was brought forward. Not so long ago such a sum would have staggered the legislature and the people, but when the question was submitted to the latter in November, 1903, it was approved by a vote of 673,010 against 427,698. This contemplates the enlargement of the prism of the Erie from 70 to 122 feet at surface and of the depth to 12 feet instead of 9; accommodating boats 150 feet long instead of 98, with draught of 10 feet in place of $7\frac{1}{2}$, thus more than trebling the present carrying capacity.

Since 1892 the average annual tonnage of the canals has been 3,600,000, an annual average loss of 1,400,000 tons compared with the preceding decade. A slight improvement was shown in 1906 over previous years, due to the enormous increase in traffic generally. It is estimated that the average freight rate per ton does not exceed 60¢, making total freight earnings per year \$2,100,000 as against \$7,679,000 in 1871. The railways reaching New York and competing with the canals now carry 70,000,000 tons annually; the canals carry less than 5% of that tonnage.

Several years must pass before the improvements now under way are complete and the wisdom of the same tested by actual experience. There can be no rational doubt of the necessity of modernizing the canals and bringing their capacity up to present commercial needs. It is incontestable that the Erie Canal has proved enormously beneficial in the past. In length it is second only to the Great Canal of China, among the artificial commercial waterways of the world. For a quarter of a century it was the greatest transportation line

in the country, and this was during the country's first industrial and commercial growth, the most important in this respect, since the country had not yet attained financial strength. Its benefits were not confined to the people of the State; they extended on the one hand to the people of the West country, giving them an outlet for their products and stimulating their development and prosperity; it gave the people of the East, and notably to New England, and also to Europe, cheaper transportation, which meant lower prices to the consumer, particularly of food products. It not only furnished cheap transportation, but compelled the railroads to transport goods at reasonable rates.

The all-rail rate from Chicago to New York is the base line upon which all railroad rates east of the Mississippi and north of the Ohio are fixed, and to which they are proportioned.¹ The all-rail rate from Chicago to New York has been steadily lowered to meet the water rate (by lakes, canal, and river) from Chicago to New York. In this way the Erie Canal has

¹ Testimony of Albert Finck before the Hepburn Committee.

been the regulator of railway rates, and has cheapened freights to all people of the State and directly benefited them, whether they reside in the canal counties, or in the Southern tier, or in the St. Lawrence Valley. For instance, the all-rail rate in 1868 upon wheat, Chicago to New York, was 42.6¢ per bushel; in 1879 it was 20¢, and in late years it has averaged under 11¢. Carried by lake steamer to Buffalo and by canal and river to New York, the rate was 23¢ in 1868, 12¢ in 1879, and has been 5¢ in recent years.

We have noted the enormous revenues which the Erie Canal paid into the State treasury. More important still, it was the chief, if not indispensable, factor in building up a chain of towns and cities along the routes, which make the State first in population, and also in fostering the rapid development of wealth, placing the State in the lead in that respect among the commonwealths of the Union. It was the channel through which were poured the raw products of the West into the archives of New York; and in turn finished products were carried to Western consumers, until New York

City, during the period 1868-1872, enjoyed 56% of the total export trade of the whole country; it now enjoys less than 35%.

In 1820 the population of the State was 1,373,000; its assessed valuation was \$256,000,000. The present population is nearly 8,000,000, and the assessed valuation is \$8,000,000,000. The State can much better afford to spend \$101,000,000 upon the canal now than it could \$10,000,000 in 1820. While conditions are not in the least similar, the State's necessity is quite as great.

The history of the canals bears upon the question, recently much discussed, of public ownership and control of transportation facilities. Here was a great and unquestionably beneficent public work, undertaken for the advantage of all the people, to provide cheaper transfers; side by side another form of transportation was developed under private auspices. While the latter was year by year improved to meet the ever growing needs, the former was permitted to degenerate. Doubtless the railway interests assisted in making the canal record a deplorable one, but this fact merely

adds emphasis to the opposition to public ownership. It is safe to say that had the canal system been privately owned by strong interests, it would not have degenerated as it did. Public service, unless under continuous stimulation, does not yet seem equal to the task imposed by such undertakings. Much remains to be done in the way of public service reform before the change to public ownership and operation can be regarded wise.

The canals of New York were necessarily built by the State. The undertaking called for too vast an expenditure to be within the means of individual or corporate enterprise, owing to the comparative poverty of our newly formed commonwealth and its undeveloped resources. Nevertheless, it is the most important instance of government ownership of a public utility which we have. It is owned and managed by the State upon the general principle upon which municipal and government ownership advocates claim that all public utilities should be owned and controlled, — in order to furnish the public good service, freed from the control and manipulation of the avaricious.

Recall its infinite delays, extravagance, and graft; recall its most unbusinesslike management; no improvement in capacity for the past 42 years, notwithstanding it has been a period of phenomenal development and prosperity; and contrast its management with that of its rivals, the railroads, as to roadbed (prism), rolling stock (boats), general equipment, general management; and surely it all must militate against the wisdom and efficiency of government ownership and control in all cases where individual enterprise may supply the need. The same reflection compels the conclusion that the present plans for improvement and development, expensive though they be, are amply justified, and that the canals should in future be managed with the solicitude and business acumen which characterizes individual enterprise.

With proper supervision of the enormous expenditure proposed; with an effective control of the management to the end that the enlarged canal shall furnish the service contemplated; and with wise economy in the place of careless extravagance, it appears entirely safe to predict that the State will receive, in increased trade,

profits of the transport lines and general growth of the municipalities along the line of operation, a return which will be proportionately as great as that which the records of the Erie show to have been realized in the past; that in less than a generation the benefits will have more than offset the entire expenditure.

In addition, great pecuniary advantage will accrue to the producers at one end and the consumers at the other, from the great reduction in the transport charges that must inevitably follow the enlargement.

IV

THE COMPETITION AGAINST NEW YORK CITY

The importance of the Erie Canal during the period of its greatest efficiency, to the commercial and industrial development of the State of New York, cannot be overestimated; it was all-powerful in making the City of New York the chief port of the United States and one of the greatest ports of the world. Mention has already been made of the relative decline of the foreign trade of New York, and

the statistics in the final chapter present the matter graphically. Compared with the volume of exports in 1890, New York in 1907 had lost \$136,000,000; compared with 1880, the figures for 1907 show a decline estimated at \$254,000,000. These losses in New York's share of exports have accrued to other ports.

A number of factors have combined to reduce the percentage of New York's export trade; unlike many of her rivals, she has no railroad interests specially devoted to her cause in the struggle for traffic. The New York Central Railroad, through its control of lines to Boston, derives just as much, if not more, advantage in carrying freight to the New England port; the other trunk lines entering from the South stop at, or pass through, rival seaboard terminals before reaching New York.

A complex system of "differentials" in through rates by rail from interior points to the seaboard discriminates against New York. The purpose of this system is to place all Atlantic seaboard points upon an equality, by offsetting in transportation charges the assumed advantages possessed by New York, both in

the matter of easier transportation, due to better gradients of her railways through the Mohawk Valley, and the somewhat lower ocean freights due to the greater competition among foreign carriers. Thus by agreement between the trunk lines, Boston, although 50 miles farther from Chicago, by the shortest route, obtains the same rate as New York. Philadelphia, Baltimore, and Newport News, all nearer the West than New York, were accorded rates lower by two to three per cent. Recent alterations in the schedule have reduced the differentials somewhat, but the ports to the South have still a substantial advantage in respect to rates.

On the other hand, New York's insular position compels the imposition of lighterage charges for the transshipment of freight from railway cars to ocean steamers; competing ports avoid this charge, because freight is transferred from terminal tracks direct to the ocean carriers. A further impost is laid upon New York's foreign trade by her very high port charges, explained, perhaps, but by no means justified, by her very inadequate dock facilities. The

crowded condition of the wharves and the channels of ingress and egress therefrom, and the narrow thoroughfares occupied so fully by other interests, necessarily impede traffic and render the same more expensive.

But the deterioration of the canal service, or, more properly speaking, the failure to maintain and develop it, to keep pace with the advancing needs of trade, are mainly responsible for the relative falling off of New York's foreign trade, especially as to exports. The enormous export grain traffic coming through the Great Lakes demands cheaper handling than the present means available to New York afford. Transshipment from lake steamers at Buffalo, and forwarding by rail to the metropolis, involves a charge of 5¢ per bushel. By canal the charge is substantially the same. The Canadian route, *via* the Welland Canal, Lake Ontario, and the now efficiently canalized St. Lawrence River, affords a transfer at so much lower rates, that the estimated cost of conveying the bushel of grain from Duluth, or other primary lake points, to Montreal, where transatlantic steamers take the cargo, is only 5¢.

Freight has no consideration of patriotism ; obedient to imperious economic law, it will move along the line of least expense. The St. Lawrence route, completed, as to the latest improvements, in 1900, is now by far the shortest and cheapest, and Montreal and the Dominion are profiting from the large but judicious outlays of public money upon this waterway. Unless the rivalry is adequately met, it is only a question of time when the bulk of the enormous trade of the rapidly developing Northwest, will reach the markets of the world through the Canadian route, whether originating in the Dominion or in the United States.

The freight which passes through the two canals (American and Canadian) at Sault Ste. Marie reached an aggregate of 58,000,000 tons in 1907, an increase of 14,000,000 tons in two years. The capacity of the vessels engaged in lake traffic and utilizing these canals has been enlarged almost annually. To meet these developments the Canadian Government improved its great waterway to the seaboard, so as to admit the passage of vessels of 2200

tons burthen. As shown in the tables in the Appendix, the capacity of the locks of the Canadian canals is more than twice that of the locks of the Erie. Canada is thus able to take advantage of the fact that the route from Chicago or Duluth to Liverpool, *via* Montreal, is 450 miles shorter than *via* New York. Following this expenditure of many millions, further improvements are now contemplated in order to enlarge the facilities and diminish the obstacles and expense still more. For a decade past, another and still shorter route has been under consideration from Georgian Bay to Montreal *via* the Ottawa River.

The proposed Georgian Bay route, which was practically indorsed by the people of the Dominion at their recent election, contemplates a waterway 430 miles in length, with a depth of 22 feet, and locks 650 feet long and 65 feet wide. The cost is estimated at from \$90,000,000 to \$100,000,000. The route includes, in the 430 miles of length, fully 400 miles of sheltered lake and river, susceptible of economical improvement. Of the 30 miles of actual canal required, nearly one half, in the vicinity

of Montreal, already exists, but would, of course, require deepening and enlargement. This route will save approximately 340 miles of navigation as compared with the route *via* the Lakes and River St. Lawrence, and will make the distance from Chicago or Duluth to Liverpool, *via* the proposed canal, approximately 800 miles shorter than *via* New York.

A canal to connect Lakes Winnipeg and Superior, thus bringing water transportation hundreds of miles nearer the grain fields of the Saskatchewan, has been proposed by James J. Hill.

These are the competitive factors which New York proposes to meet by the enlargement of the Erie Canal; it is the sole remaining resource. Only recently a number of large freighters of transatlantic lines operating from New York were for a time taken off from service; the representatives of the ocean-carrying companies protested to the railway companies against their scale of charges upon grain, which they assert make the transportation cost to Europe *via* New York prohibitive, as compared with the Montreal route. But the railways

have troubles of their own, and are struggling with serious problems which apparently preclude their reducing these charges. The canal is the only means in sight to stay the further decline of the commerce of the port of New York.

The trunk lines terminating at the seaboard have by agreement bargained away all of New York's natural advantages, and the crucial facts of present experience prove that the railroads cannot maintain the commerce of the United States, in competition with Canadian waterways. It is no longer a question of competition between rail and water,—the question is, Can the canalization of our water routes so supplement the railroads that, working together, they can retain for the United States the foreign commerce to which it is normally entitled?

The canal improvement under way, when completed, means that larger vessels, each carrying 33,000 bushels of grain, and operated in fleets instead of singly, could reduce the time now required to transfer freight from Buffalo to New York by water at least 50 per cent, with a consequent reduction in charges in about the same proportion. It is

claimed that wheat can be carried from Chicago to New York at a cost of $2\frac{1}{2}\phi$ per bushel by this improved transportation line; adding elevator charges at Buffalo, $\frac{5}{8}\phi$ per bushel, and cost of handling at New York, would make a total cost of 4.6ϕ from Chicago on board vessel at New York;¹ and a similar reduction of charges upon other freight, not requiring speedy transfer, is hoped for.

But the people of New York do not appear to be fully awake to the need of an early completion of their great canal improvement. After the lapse of four years since the requisite legislation for the purpose was obtained, the work actually under way constitutes about one third of the contemplated work, the estimated cost of the part under contract being about \$33,000,000. Plans for nearly one third of the work are as yet incomplete; for the remainder, also about one third of the entire work, the plans and estimates are taking their slow course through the hands of the engineers, the Canal Board, the Advisory Board, to the stage of advertising for bids of contractors.

¹ Greene's Report, 1899, p. 37.

Unless much greater progress can be made, the benefits to accrue to the State, and to the port of New York, will not be adequately realized. Competitors are by no means inactive, and the lapse of time may bring new competitive conditions which even the results from the great expenditure upon the Erie will not prove sufficient to overcome.

To illustrate concretely the force of the Canadian competition as it affects all of the Atlantic seaboard ports of the United States, it is pertinent to give the following comparative figures:—

For the seven years prior to 1901, the total receipts of grain (including flour at the rate of $4\frac{1}{2}$ bushels of wheat to the barrel) averaged, for these ports and Montreal, 408 million bushels annually, of which the Canadian port took 31 million bushels, or about 7.7 %.

For the seven years 1901 to 1907, the annual average was 314 million bushels, Montreal taking 34 millions, or about 10.5 % of the total.

In 1907 the Canadian route carried 43 million bushels out of a total of 355 millions, or a ratio of 12 %, whereas in 1900, before the completion of her canal improvements, the Canadian ratio

was only $7\frac{1}{2}\%$. For 1908 the ratio will certainly be materially larger than for 1907.

The Erie Canal has, during the greater part of its existence, been regarded as a competitor of the railways; has been fiercely fought and unceasingly hampered; all improvements tending to increase its efficiency have been vigorously opposed by the powerful railway interests; the railways, through their tax-paying obligations, are joint owners of the canals in common with all other interests in the State; under the specious plea of economy and by use of their great influence in matters of legislation, they have made themselves largely responsible for the inefficient canal policy of the State. The important consideration that waterways are needed to supplement the land routes, has not been given due weight. The Canadian Pacific Railway gathers the grain from the outlying fields, transfers it to lake steamers, which carry it by canals and rivers to Montreal, where the Canadian Pacific's Atlantic steamers take it to Liverpool. This supplementing and coöperating of the three classes of transport facilities unquestionably

brings success in competition with the system prevailing in the United States.

There are two pertinent examples of the effect of coöperation in the use of transport facilities in foreign trade:—

The port of Galveston, Texas, returned exports valued at \$24,000,000 in 1890; \$41,900,000 in 1895, and \$85,600,000 in 1900; in 1907 the total had risen to \$237,400,000, and although the imports are insignificant, that port ranks second only to New York in the aggregate of its foreign commerce.

The port of Puget Sound reported in 1890, \$3,300,000 of exports, and San Francisco \$36,800,000; in 1900 the former reported \$17,900,000 and the latter \$40,300,000; by 1905 the exports of Puget Sound were valued at \$43,800,000, and those of San Francisco at \$49,900,000. The injury wrought to San Francisco's trade by the serious earthquake and fire in 1906 should be given due consideration in comparing subsequent statistics, the movement at Washington's port having exceeded by nearly \$10,000,000 the exports of that of California in 1906.

THE PANAMA CANAL

No discussion of the influence of artificial waterways upon the economic future of the world would be complete without mention of the gigantic undertaking of the Government of the United States to complete the abandoned French enterprise of connecting the Atlantic and Pacific oceans at the Isthmus of Panama.

The advantage of such a canal was clearly perceived as early as 1520, when Charles V of Spain is reported to have given it consideration. In 1534 a survey was ordered, but unfavorable reports of the Spanish governor of Panama, and probably also his suggestion that such a work would be in "opposition to the will of the Almighty, who had placed this barrier in the way of navigation between the two oceans," caused the project to be abandoned; and although revived at later periods, it never took practical form until about 1878, when French interests obtained a concession from the re-

public of Colombia. De Lesseps, who had built the Suez Canal, became the chief spirit in the enterprise undertaken by a corporation formed in 1879.

Actual operations were delayed until 1883; lavish expenditures, stock jobbing, and technical errors brought the company to bankruptcy in six years. Then the concession expired, and it was only after much delay that a renewal was obtained, under which a new company was organized in 1894. The plans of this corporation also proved unsuccessful, and work was practically abandoned. The concession was for ten years, thus expiring in 1904; in another grant from Colombia it was conditioned that the canal should be completed by 1910.

Both private interests and the Government, in the United States, had for many years given attention to the subject of an interoceanic canal; the Nicaragua route for a time found much favor. In June, 1902, Congress passed a law under which the Government was to undertake the construction of an Isthmian waterway, and finally it was determined that the Panama route be used, provided the French interests

could be acquired and suitable arrangements made with the Government of Colombia. The former condition was satisfactorily negotiated in a short time, but Colombia, which had been for about a decade torn by civil war, was not disposed to grant all the needed privileges asked for. Inasmuch as the question of selecting the route depended upon this contingency, the people of the State of Panama, who naturally had the largest interest in the use of that isthmus, concluded to secede from the federal republic of Colombia and take matters in their own hands. When this was accomplished, in November, 1903, the requisite concessions were speedily granted.

For the rights and property of the French company the United States paid \$40,000,000; this included the Panama Railroad, which the company had acquired. For the exclusive ownership and control of a strip of territory of five miles on each side of the proposed canal, the new republic of Panama received \$10,000,000. (After nine years there is also to be paid an annual stipend of \$250,000.) It is generally believed that the total cost, including the above-

named disbursements, will exceed \$200,000,000. Congress has authorized the borrowing of that sum through an issue of thirty-year 2% bonds

While the superiority of the Panama route over others which had been considered was not decided upon without a long contest, and while expert engineers are not altogether of one mind as to the feasibility of the project, owing to the many natural obstacles to be encountered, the preponderant opinion of the highest authorities in the engineering field gives ground for belief that the obstacles will be mastered by the greatly advanced methods of the profession.

It is gratifying to note that despite some discouraging experiences due to causes not entirely dissociated from political considerations, the energetic steps taken by President Roosevelt, ably seconded by his War Secretaries Root and Taft, have resulted in speedier progress than many of the critics regarded as probable; particularly has this been the case since the work was placed in charge of members of the Corps of Engineers of the Army.

The canal is to be of the lock class; its

length will be about 46 miles, the depth from 30 to 45 feet; width from 200 to 1000 feet. Upon the actual work of digging the canal over \$65,000,000 has already been expended; in addition about \$13,000,000 has been used for sanitary and municipal improvements; the aggregate disbursements up to date (July 31, 1908) have been \$128,500,000. Nearly 50,000 persons are employed upon the entire project. Excavation work has reached an average of over 2,500,000 cubic yards per month, and a maximum of over 3,000,000 cubic yards in a single month. The total excavation required is estimated at 223,548,000 cubic yards; 40,700,000 cubic yards have been removed by our engineers, and about the same quantity of work done by the French is such as can be utilized.

This great enterprise, when finished, as it may be within five years, is destined to prove to the commercial world the most valuable of such works yet undertaken. The development of the trade between the Pacific and the Atlantic, by shortening and hence cheapening the cost of the transfer, will obviously be great. The elimination of a very large part of the

transcontinental railway charge upon commodities from the territory of the United States east of the Mississippi River will bring them nearer to the teeming peoples of Asia, numbering fully 750 million souls, not to speak of the rapidly growing Australasian commonwealth and the islands of the sea.

The cost of the double transshipment from vessel to railway at Colon and from railway to vessel at Panama, now unavoidable in traffic between the oceans *via* the Isthmian route, will be superseded by a simple and reasonable toll charge.

The Pacific ports of the United States will be nearer to the Atlantic ports, comparing the all-water route *via* Cape Horn, by nearly 8000 miles; and those of Chile, Peru, etc., will be brought nearer New York by from 4000 to 6000 miles. Yokohama and Shanghai, Manila and Sidney, will be also from 8000 to 4000 miles nearer. The proximity of the Gulf ports promises to afford the Southern States of the Union a great opportunity for industrial and commercial development.

The cotton and grain going to Japan and

China will be delivered at less cost, and the demand for these commodities will naturally expand. The use of the Mississippi and its tributaries will be almost certainly revived, and the Father of Waters may recover its former commercial importance.

Nor will the advantage accrue entirely to the United States; for although the difference in distance between the ports of western Europe and the Orient, *via* Suez and *via* Panama, is not substantially important, that between those ports and the Pacific ports of both North and South America and points in Oceanica will be materially shortened by the Panama waterway. Moreover, by a competitive toll rate *via* Panama, a considerable part of the Asiatic traffic will doubtless be diverted from Suez.

Estimates as to the probable tonnage that will use the canal vary; a reasonable one is about 6,000,000 tons, crediting by far the greater part to freight from Atlantic and Gulf ports of the United States. This, it is confidently expected, will show increases almost annually, just as was the case in the history of the Suez

Canal. Placing the cost of operation at about \$2,000,000 annually, the net earnings, if tolls were, as is suggested, placed at \$1 per ton, would just cover the interest on the bonds to be issued to finance the project.

Obviously, private capital could not have been induced to undertake the enterprise upon such a showing. Yet it is to be noted that the Suez charges (for a canal about twice as long) amount to \$2 per ton. Its net tonnage transit did not reach 6,000,000 net tons until 1885; it is now upward of 12,000,000 net tons annually.

While the Panama waterway is to be neutral, that is, open to all nations, it is patent that its control by the United States is of almost incalculable importance in the event of war. The experience during the Spanish War, and the more recent experimental test of sending a full fleet around the Horn, are circumstances which clearly show the strategic importance of the short waterway.

Without the Panama Canal the United States, in the proper defense of its coast line, as well as the enforcement and protection of its rights, would be compelled to maintain two first-

class navies,—one in the Atlantic and one in the Pacific; since, in the event of war, months must elapse ere war vessels on either coast could be made available on the other. The lessened cost of naval expenditure, apart from the advantage to commerce, will therefore fully justify the expenditure in building the canal by the United States.

THE WATERWAYS QUESTION AND CONSERVATION OF OUR RE- SOURCES

THE rehabilitation of both the artificial and the natural waterways in the United States has been brought prominently forward for *national* consideration by reason of the inability of the land routes to give adequate service at periods of special pressure. In the fall of 1906 both our cotton and our grain crops were several weeks late in reaching market for lack of transportation means. The delay was caused not so much by want of rolling stock, as by insufficient roadbeds and terminals. As population increased, factories, warehouses, docks, and all the structures designed to house and expedite commerce, were builded about the railways and their depots, until now they are wedged in as by a vise. They periodically lack trackage and terminals sufficient to enable them to do the business which offers. The space they need to enable them to

double, treble, or quadruple track their roads and enlarge their terminals, can only be obtained at almost prohibitive prices, and in many instances is unattainable. As population becomes still more dense and our civilization more complex, our production and commerce expanding, these essential conditions of land transport will become more difficult; the water routes will unavoidably be resorted to for the solution of the problems thus presented.

History shows that enterprise, in its various forms, moves in waves, with maximum and minimum growth and periods of stagnation or comparative inactivity. In the development of a new country, under the impulse to anticipate the future, to realize presently the greatest possible profit, it was but natural that the rapid transportation of the railway would monopolize the public interest, and canal transportation be voted too slow. Small wonder that canal construction should be neglected, under the circumstances, and even existing canals be permitted to fall into disuse and be abandoned. With denser population and overtaxed transportation facilities, the tide has turned; the

public, confronted by conditions, not theories, realize that rail transportation must be supplemented and complemented by inland water routes. Other nations have far surpassed us in these respects, and we are bound to follow in the wake of this world-wide influence. There are powerful factors at work in favor of the canalization of our rivers and lakes. A national movement for the conservation of our national resources has been inaugurated by Congress. The President convened the Governors of all the States to meet other distinguished men, to consider the same question. The scope of this policy can best be stated in the words of Senator Newlands:¹ —

“A comprehensive plan for the development of our waterways of necessity takes into consideration all of the related questions of forest preservation and restoration, of the irrigation of arid lands, of the reclamation of swamp lands, of bank protection, of clarification of streams and other kindred subjects, as well as of canal construction. It does not mean simply getting a dredging machine for the purpose of removing sandbars, and digging a channel. It involves the prevention of floods, when the rivers rush down in torrential streams, destroying property, and then, having wasted the water in the ocean, are attenuated till boats

¹ *North American Review.*

cannot float upon them. It involves the preservation of forests, because forests are the great conservators of moisture and aid in the gradual distribution to the rivers. It involves the question of irrigation of arid lands at the head waters of our inland rivers — the creation of great reservoirs, where the flood waters can be impounded and led over the plains for purposes of irrigation, to be gradually returned to the rivers when most required by them. Where it cannot be advantageous to irrigation, the water can be kept impounded, — as is now done in the upper Mississippi and in some foreign countries, — to be let out at a time of low water in such a manner as to maintain navigation throughout the summer.

“Forestry and irrigation are both essential to the prevention of floods and soil waste and to the maintenance of a stable channel for navigation, besides creating vast money values and great happiness and comfort in the development of immense forests and broad plains irrigated to almost unlimited productiveness. The artificializing of a river means that it shall be kept at a standard depth, to accommodate vessels of standard draft, just as there is a standard gauge for railroads. . . .

“It also involves the reclamation of swamp lands, which means the addition of large and immensely fertile areas to the productive resources of the country. THE RECLAMATION OF SWAMP LANDS AS SUCH IS NOT ONE OF THE POWERS OF GOVERNMENT GRANTED BY THE CONSTITUTION, BUT THE CONTROL OF THE RIVER FOR PURPOSES OF NAVIGATION IS, AND FOR THIS PURPOSE THE REDEMPTION OF VAST SWAMPS, ALONG THE LOWER REACHES OF THE RIVERS, IS AS MUCH A FUNCTION OF THE GOVERNMENT AS THE IRRIGATION OF ARID AND SEMI-ARID WASTES

AT THE SOURCE OF THE RIVERS. The channels fill up because where there are broad stretches of lowland, over which the river spreads, in high water, the river channel is lost in a network of bayous and swamps. When confined in comparatively narrow channels, by means of levees, the current is restrained and quickened and becomes an effective power in scouring instead of clogging the bottom, and in preserving the channel; so that we have inseparably connected with the question of navigation, the redemption of swamp lands and bank protection."

The Government, through its power to regulate interstate commerce, will make canalization incidentally cover irrigation, forest-preservation, drainage, clarification, bank-preservation. With an open Treasury little difficulty will be encountered from strict constructionists of the Constitution; the reserved rights of the States will hardly assert themselves to prevent expenditure of money which must inure largely to their local benefit. An abstract proposition, infringing State sovereignty, would be resisted, but a concrete project, flavored with Treasury notes, will pass unchallenged.

Mark the evolution of constitutional construction; mark also the return of the canal to popular favor. Deep-water navigation from

St. Louis to the Gulf commands the approval of railway managers, as well as publicists, and is knocking at the Treasury door with inviting countenance from within. The faith and prestige of our Nation before the world are committed to the speedy construction of the Panama Canal. Such powerful examples must exercise a contagious local influence throughout the country.

APPENDIX

ESPECIAL attention is directed to the following tables, which, it is believed, comprise in compact comparative form all the essential statistical history of the State canals, as shown by the official reports made annually by the State officers in charge, of the result of the adverse conditions upon the commerce of the Port of New York and other collateral data of interest in the consideration of the subject.

GROUP "A," RELATING TO CANALS OF NEW YORK STATE

Table I, period of construction, mileage, etc.

Table II, the several actual and proposed enlargements of the Erie Canal.

Table III, cost of construction and maintenance, and revenue, until tolls were abolished.

Table IV, cost of canals separately stated; revenue, with interest allowance.

Table V, volume of traffic, toll and freight rates, by 5-year periods.

Table VI, value of commodities transported, by 5-year periods.

Table VII, revenues, expenses, and freights paid, by 5-year periods.

Table VIII, railway competition, tonnage, and cost of transportation compared.

GROUP "B," RELATING TO THE COMMERCE OF NEW YORK, ETC.

Table IX, Commerce of the United States and New York's share, (*a*) prior to 1858; (*b*) 1858-1907.

Table X, grain and flour movement and relative receipts at seaboard terminal cities.

Table XI, growth of New York by periods, thus enabling canal influence to be noted.

GROUP "C." MISCELLANEOUS STATISTICS

Table XII, statistics relating to the Commerce of the Great Lakes.

Table XIII, Canadian canals (Lakes to Seaboard).

Table XIV, brief data as to progress of Panama Canal.

Table XV, Expenditures on Panama Canal, to July 31, 1908.

STATISTICAL TABLES
(A) RELATING TO THE CANALS OF NEW YORK STATE AND THEIR OPERATIONS
I. EXTENT OF WORKS, ETC.

	WORK BEGUN	OPEN- ING	COM- PLETED	TOTAL WORK, MILES	EFFECTIVE 1906		TERMINALS, ETC.
					Canals	Feeders	
Erie	1817	1819	1825	381	352	3	Albany to Buffalo
Champlain	1817	1819	1822	81	66	15	West Troy to Whitehall
Oswego	1825	1828	1829	77	38	39	Oswego to Syracuse, with river improve- ments
Cayuga and Seneca	1826	1826	1829	25	23	2	* Montezuma to Geneva
Black River . . .	1837	1849	1852	118	35	56	* Rome to Lyon's Falls, with river im- provements
Chemung	1830	1834	1834	39			Abandoned 1879
Crooked Lake . .	1831	1834	1834	8			Abandoned 1875
Chenango	1833	1837	1840	127			Abandoned 1876
Genesee Valley . .	1837	1841	1844	125			Abandoned 1879
Oneida Lake . . .	1841	1841	1841	7		7	Not navigable ; used as feeder only
Total mileage . .				968	514	122	

* Now used chiefly as navigable feeders.

II. THE ERIE CANAL

(Dimensions, actual and proposed)

YEARS	DIMENSIONS OF PRISM, FEET	DIMENSIONS OF LOCKS, FEET	CAPACITY FOR VESSELS			COST OF TRANSFER PER		
			Feet	Tons	Bushels	To	Bushel	Ton-mile
1819-1830	40 × 28 × 4	90 × 15 × 4	61 × 7 × 3½	30	1,000			
1831-1849	In process of enlargement	In process of enlargement and partly doubled	75 × 12 × 3½	75	2,500			
1850-1860			90 × 15 × 3½	100	3,333	cents	cents	mills
1861-1906	70 × 56 × 7	110 × 18 × 7	98 × 17½ × 6	240	8,000	87	2.62	1.75
<i>Proposed</i>								
* 1895	70 × 56 × 9	*	98 × 17½ × 7½	320	10,666	58	1.75	1.16
† 1898	70 × 56 × 9	260 × 35 × 9	125 × 17½ × 8	450	15,000	44	1.32	.88
‡ 1903	122 × 75 × 12	310 × 28 × 11	150 × 25 × 10	1,000	33,333	26	.80	.52

* \$9,000,000 plan, increasing number of double locks. † \$21,000,000 plan. ‡ \$101,000,000 plan, adopted and in progress.

III. REVENUE AND EXPENSE OF CANALS FROM 1817 TO 1882, WHEN TOLLS WERE ABOLISHED

CANALS, ETC.	GROSS REVENUES	OPERATION AND MAINTENANCE Cost	RESULT GAIN + ; LOSS -	COST OF CON- STRUCTION AND IMPROVEMENT	BALANCES
Erie	\$121,461,871	\$29,270,301	+\$92,191,570	\$49,591,853	Profit, \$42,599,718
Champlain	6,416,341	5,630,024	+ 786,318	4,913,296	Loss, 4,126,978
Oswego	3,708,548	3,371,446	+ 337,102	4,295,373	" 3,958,271
Cayuga and Seneca .	1,054,356	1,027,539	+ 26,817	1,834,184	" 1,807,367
Black River	301,100	1,552,230	- 1,251,130	3,894,952	" 5,146,083
Oneida Lake	65,894	144,060	- 78,166	511,649	" 589,816
Crooked Lake	45,490	424,658	- 379,168	395,091	" 774,260
Chemung	525,565	2,022,259	- 1,496,694	1,463,586	" 2,960,280
Chenango	744,027	2,081,739	- 1,337,712	4,789,471	" 6,127,181
Genesee Valley . . .	860,165	2,814,809	- 1,954,644	6,737,430	" 8,692,074
Lesser works	234,968	60,222	+ 174,747	258,695	" 83,948
Totals	\$135,418,325	\$48,399,287	+\$87,019,038	\$78,685,580	Net Profit, \$8,333,458

Ratio of Operation and Maintenance to Revenues: All - 35½%; Erie - 24%

IV. FINANCIAL EXHIBIT OF COST OF CANALS

(In millions of dollars)

	To 1882, ACTUAL				To 1905, APPROXIMATE, EXCLUSIVE OF \$101,000,000 APPROPRIATION			
	Erie	Four Others	Abandoned	All	Erie	Four Others	Abandoned	All
Construction cost . . .	49.6	15.7	13.4	78.7	57.6	16.7	13.4	87.7
Operation, etc.	29.3	11.7	7.4	48.4	49.0	17.9	7.4	74.3
Total	78.9	27.4	20.8	127.1	106.6	34.6	20.8	162.0
Revenue	121.5	11.7	2.2	135.4	121.5	11.7	2.2	135.4
Apparent gain	42.6	—	—	8.3	14.9	—	—	—
Apparent loss	—	15.7	18.6	—	—	22.9	18.6	26.6
Interest apportioned on cost	29.9	9.5	7.9	47.3	34.5	10.4	8.5	53.4
Gain	12.7	—	—	—	—	—	—	—
Loss	—	25.2	26.5	39.0	19.6	33.3	27.1	80.0
Net cost	39.0				80.0			
Canal debt outstanding . . .	9.0				8.5			
Total bond issue was . . .	64.7				73.2			

V. TRAFFIC OF THE CANALS, TOLL AND FREIGHT RATES, BY FIVE-YEAR PERIODS AND AVERAGES

MOVEMENT IN MILLIONS OF TONS										AVERAGE TOLL AND FREIGHT RATES			
Periods	Total	Annual Average	Erie's Total	Annual Average	Tide Water Traffic			Local Traffic All	Buffalo to Albany		Albany to Buffalo		
					Down	Erie's			Tolls	Net Fgt.	Tolls	Net Fgt.	
						Up	Down						
1823-27	*1.3	0.3	1.2	0.2	0.6	0.2	0.4	0.5	†	†	†	†	
1828-32	*2.6	0.5	2.0	0.4	1.6	0.3	1.2	0.7	\$5.11	\$10.22	\$	9.78	
1833-37	*5.0	1.1	3.0	0.6	3.0	0.7	2.0	1.3	3.37	3.98	7.01	10.23	
1838-42	6.9	1.4	4.0	0.8	3.3	0.7	2.2	2.9	3.28	3.48	6.57	8.87	
1843-47	10.4	2.1	5.7	1.1	6.2	1.0	4.9	3.2	3.14	3.01	6.21	3.71	
1848-52	16.2	3.2	8.9	1.8	9.3	2.1	6.9	4.8	2.63	2.50	4.34	2.38	
1853-57	19.9	4.0	10.3	2.1	11.3	2.5	7.7	6.1	2.19	2.88	3.12	1.93	
1858-62	22.2	4.4	11.5	2.3	13.3	1.7	10.5	7.2	1.70	2.01	1.12	1.30	
1863-67	26.6	5.3	13.8	2.8	14.1	2.8	11.5	9.7	2.11	2.52	1.05	1.55	
1868-72	31.6	6.3	16.4	3.3	16.6	4.5	12.2	10.5	1.47	2.45	1.05	1.55	
1873-77	26.1	5.2	15.1	3.0	14.6	4.0	10.9	7.5	.81	1.63	1.05	1.55	
1878-82	27.6	5.5	19.3	3.9	17.1	5.1	12.8	5.4	.37	1.12	.46	1.42	
1883-87	26.2	5.2	17.3	3.5	14.9	4.8	11.0	6.5	†	†	†	†	
1888-92	24.4	4.9	16.4	3.3	12.9	4.3	9.1	7.2	†	†	†	†	
1893-97	19.0	3.8	14.0	2.8	10.3	4.0	8.2	4.7	†	†	†	†	
1898-02	17.1	3.4	11.2	2.2	7.1	4.2	5.2	5.8	†	†	†	†	
1903-07	16.8	3.3	11.1	2.2	5.1	3.0	5.0	6.5	†	†	†	†	

* Estimated and partly estimated; actual reports begin 1836.

† No actual data before 1830, nor after 1882.

† Tolls abolished after 1882.

VI. VALUE OF COMMODITIES TRANSPORTED, BY FIVE-YEAR PERIODS AND AVERAGES

Periods	IN MILLIONS OF DOLLARS				VALUES PER TON	
	Total	Annual Average	Eric's Share		Total	Tide Water
			Total	Average		
1823-27	*65	13	60	12	30	6
1828-32	*130	26	100	20	70	14
1833-37	†240	48	150	30	120	24
1838-42	358	72	314	63	116	23
1843-47	535	107	441	88	232	46
1848-52	798	160	673	135	279	56
1853-57	977	195	803	161	345	69
1858-62	775	155	577	115	376	75
1863-67	1320	264	981	196	635	127
1868-72	1246	249	958	192	601	120
1873-77	786	157	602	120	446	89
1878-82	1025	205	881	176	462	92
1883-87	760	152	627	125	327	65
1888-92	706	141	548	110	315	63
1893-97	589	118	507	101	236	47
1898-02	430	86	341	68	122	24
1903-07	332	66	222	44	92	18

* Estimated ; no actual reports.

† Partly estimated ; reports begin 1837.

VII. REVENUES, EXPENSES, FREIGHTS PAID, BY FIVE-YEAR PERIODS WITH AVERAGES

(In Millions of Dollars)

TOLLS TO STATE					RATIO EXPENSES TO TOLLS			PER TON		FREIGHT TO BOATMEN		
Periods	Total	Annual Average	Erie's Share	EXPENSES		Tolls	Expenses	Total	Annual Average	Per Ton		
				Total †	Annual Average							
1823-27	2.6	0.5	2.4	1.5	0.3	\$1.24	\$1.15	2.6	0.5	\$1.24		
1828-32	5.2	1.0	4.5	1.7	0.3	1.48	.64	5.2	1.0	1.48		
1833-37	7.3	1.5	6.7	2.6	0.5	1.46	.52	7.8	1.6	1.56		
1838-42	8.7	1.7	7.8	2.8	0.6	1.26	.41	10.0	2.0	1.45		
1843-47	13.5	2.7	12.2	3.2	0.6	1.30	.31	12.6	2.5	1.21		
1848-52	16.2	3.2	14.7	4.3	0.9	1.00	.26	14.4	2.9	.89		
1853-57	13.6	2.7	11.1	5.0	1.0	.68	.25	15.9	3.2	.80		
1858-62	16.0	3.2	13.3	4.2	0.8	.72	.19	20.4	4.1	.92		
1863-67	21.0	4.2	18.7	6.3	1.3	.79	.24	25.5	5.1	.96		
1868-72	16.8	3.4	14.9	8.7	1.7	.53	.27	29.7	5.9	.94		
1873-77	9.4	1.9	8.5	6.5	1.3	.36	.25	20.5	4.1	.78		
1878-82	4.4	0.9	4.0	4.2	0.8	.16	.15	17.9	3.6	.65		
1883-87	*	*	*	3.8	0.8	*	.14	†16.2	3.2	.62		
1888-92	*	*	*	6.7	1.3	*	.27	†14.6	2.9	.60		
1893-97	*	*	*	6.5	1.3	*	.34	†11.4	2.3	.60		
1898-02	*	*	*	5.4	1.1	*	.32	† 9.9	2.0	.58		
1903-07	*	*	*	5.6	1.1	*	.33	† 9.6	1.9	.57		

* Tolls abolished 1882.

† Estimated; no data after 1882.

† Apparently part of maintenance cost as here reported was carried to account of construction subsequently.

VIII. THE RAILWAY COMPETITION (NEW YORK CENTRAL AND ERIE RAILROADS) BY
FIVE-YEAR PERIODS

Periods	FREIGHT CARRIED—MILLIONS OF TONS			TON-MILEAGE, MILLIONS			AVERAGE TON-MILE RATES		AVERAGE RATE, WHEAT PER BUSHEL, CHICAGO TO NEW YORK		
	Two Railways	Canals	% by Canals	Two Railways	Canals	% by Canals	Railways Cents	Canals Cents	All Rail Cents	Lake and Rail Cents	Lake and Canal Cents
1853-57	7.7	19.9	72.1	1344	4617	79.0	2.80	1.10	†	†	25.0
1858-62	12.5	22.2	64.0	2353	5899	71.5	2.21	.90	39.5	†	22.3
1863-67	23.2	22.6	53.4	4156	6839	62.2	1.81	.67	49.0	†	25.9
1868-72	42.3	31.6	42.7	6893	7449	52.0	1.44	.76	35.1	26.0	22.0
1873-77	61.8	26.1	26.0	12,583	6231	33.0	1.11	.64	24.6	17.2	13.1
1878-82	95.5	27.6	18.8	20,354	7421	26.7	.82	.42	16.8	12.3	9.8
1883-87	142.3	26.2	12.8	24,514	*6640	20.7	.75	.30	15.2	10.7	7.5
1888-92	201.6	24.4	8.7	32,571	*6000	15.5	.69	.25	14.6	8.9	6.0
1893-97	210.0	19.0	6.5	35,913	*4990	12.2	.62	.20	12.8	7.4	4.9
1898-02	289.1	17.1	5.6	52,158	*4500	7.8	.58	.19	10.6	5.6	5.0
1903-07	337.4	16.9	4.8	†61,000	*4200	6.8	.63	.20	10.9	6.2	5.6

* Estimated; no records kept.

† No data.

† Estimated.

(B) COLLATERAL STATISTICS, RELATING TO THE COMMERCE OF NEW YORK

IX. FOREIGN COMMERCE OF UNITED STATES, AND NEW YORK'S SHARE

a. Prior to 1858; from various sources. (In millions of dollars.)

NEW YORK CHAMBER OF COMMERCE REPORTS										DOMESTIC MERCHANDISE EXPORTS CREDITED TO CERTAIN STATES, AND TOTAL — U.S. TREASURY REPORTS								
Periods	Imports, including Specie				Exports and Reexports				N.Y.	La.	Mass.	Pa.	Ga.	S.C.	Md.	Total	% N.Y.	
	U.S.	N.Y. State	% N.Y.	U.S.	N.Y. State	% N.Y.												
1813-17	—	—	—	—	—	—	39	20	17	17	23	31	18	211	18.5			
1818-22	—	—	—	—	—	—	38	44	22	15	35	42	19	270	14.1			
1823-27	369	190	51.5	410	123	30.0	71	44	20	17	26	41	16	276	25.7			
1828-32	438	222	50.1	388	114	29.3	69	61	20	14	23	36	16	290	24.0			
1833-37	723	415	57.4	562	137	24.4	87	135	26	12	42	55	16	455	19.1			
1838-42	551	362	65.7	588	151	25.7	107	174	31	20	29	47	23	512	20.9			
1843-47	559	277	49.5	582	172	29.6	140	154	36	21	21	41	29	529	26.5			
1848-52	909	572	62.9	920	325	35.3	259	217	48	25	32	46	33	792	32.7			
1853-57	1509	985	65.2	1474	568	38.5	497	355	112	36	38	73	40	1363	36.4			

NOTE. — Treasury department statistics of commerce, by ports, date from 1856 only.

b. 1858-1907; U.S. Bureau of Statistics reports. (In millions of dollars.)

Periods	IMPORTS			EXPORTS			EXPORTS AT OTHER PORTS							
	U. S.	N.Y. City	% N.Y.	U.S.	N.Y. City	% N.Y.	New Orleans	%	Boston	%	Balti- more	%	Phila- delphia	%
1858-62	1427	928	65.0	1308	466	35.6	305	23.3	54	4.1	48	3.7	35	2.7
1863-67	1629	1135	69.6	1172	1008	86.0	193	16.4	62	5.3	39	3.3	50	4.3
1868-72	2357	1565	66.4	1758	988	56.2	425	24.1	61	3.4	63	3.5	70	3.9
1873-77	2654	1754	66.1	2765	1381	50.0	423	15.3	141	5.1	132	4.8	136	4.9
1878-82	2918	1983	68.4	3894	1816	46.6	414	10.6	286	7.3	290	7.4	183	4.7
1883-87	3296	2217	67.2	3702	1657	44.7	428	11.6	296	8.0	230	6.2	182	5.0
1888-92	3931	2533	64.4	4211	1740	41.3	513	12.2	355	8.4	334	8.0	187	4.4
1893-97	3798	2478	65.2	4481	1810	40.4	410	9.1	446	9.9	363	8.1	211	4.7
1898-02	3889	2492	64.0	6722	2443	36.3	604	9.0	604	9.0	448	6.7	355	5.2
1903-07	5795	3527	60.9	8024	2772	34.6	768	9.6	469	5.9	467	5.9	385	4.8

X. GRAIN AND FLOUR MOVEMENT

Periods	BUFFALO RECEIPTS AND SHIPMENTS						GRAIN AND FLOUR RECEIVED AT PORTS NAMED (Million Bushels)							
	Grain, Million Bushels			Flour, Million Barrels			New York		Boston	Phila- delphia	Balti- more	New Or- leans	Men- treal	New York %
	Rec'd	Shipped by Canal	% by Canal	Rec'd	Shipped by Canal	% by Canal	Total	By Canal						
1868-72	238	185	77.7	6.6	2.3	34.8	377	231	68	86	78	68	65	50.8
1873-77	30	201	66.7	6.2	0.8	12.9	492	220	100	134	136	49	90	49.2
1878-82	366	246	67.2	5.3	0.4	7.5	739	259	162	190	247	84	04	48.4
1883-87	319	206	64.5	16.1	0.3	1.8	625	199	171	112	181	72	82	50.3
1888-92	515	185	35.9	33.8	0.2	0.6	668	156	162	158	219	106	100	47.2
1893-97	707	179	25.3	52.7	0.2	0.4	727	156	199	190	279	138	117	46.6
1898-02	747	94	12.5	53.0	0.1	0.2	780	73	242	293	386	189	180	37.7
1903-07	636	82	12.9	47.7	—	—	582	53	161	203	226	128	168	39.9

Data prior to 1868 incomplete.

XI. THE GROWTH OF NEW YORK STATE

CENSUS YEAR	POPULATION, MILLIONS	VALUATION, MILLION DOLLARS	MANUFACTURES' PRODUCT, MILLION DOLLARS	STATE TAX RATE, MILLS PER \$100	STATE DEBT, TOTAL MILLION DOLLARS	CANAL DEBT, MILLION DOLLARS	DISCOUNT BANKS	
							Capital, Mil- lion Dollars	Deposits, Mil- lion Dollars
1790	0.3	*	*	*	*	*	1.3	*
1800	0.6	*	*	*	*	*	4.7	*
1810	1.0	*	*	*	*	*	7.5	*
1820	1.4	256	*	1.00	3.0	1.5	19.0	*
1830	1.9	347	*	*	8.6	7.8	20.1	*
1840	2.4	641	96	*	18.4	14.1	36.8	16.4
1850	3.1	727	238	.50	23.5	16.2	47.4	42.0
1860	3.9	1419	379	3.80	34.2	27.1	111.4	104.1
1870	4.4	1967	785	7.25	38.6	12.0	140.2	284.7
1880	5.1	2638	1081	3.50	9.1	9.0	104.0	369.1
1890	6.0	3684	1712	2.34	5.0	4.3	113.9	540.1
1900	7.3	5461	2176	1.96	10.1	8.5	126.0	910.8
1907	8.5	8565	†2600	1.54	17.3	15.2	194.3	1218.0

* Actual data not available.

† Partly estimated.

(C) MISCELLANEOUS STATISTICS

XII. STATISTICS RELATING TO THE COMMERCE OF THE GREAT LAKES

GENERAL LAKE TRAFFIC					* ST. MARY'S FALLS CANALS TRAFFIC						
Years	Tons Carried, Millions	Tonnage of Vessels, Millions	Ton-mile Cost, Mills	Wheat, Chicago-Buffalo, Cents per Bu.	Total Traffic				Some Details		
					Net Vessel Tonnage, Millions	Net Tons, Millions	Value, Millions	Per Cent in Canadian Ships	Grain, Million Bu.	Iron Ore, Million Tons	Lumber, Million Ft.
1882	22	0.7	—	—	2.5	2.0	—	—	4.2	1.0	83
1887	20	0.8	2.30	4.13	4.9	5.5	79.0	7.0	23.8	2.5	165
1892	41	1.2	1.31	2.19	10.6	11.2	135.1	3.8	42.6	4.9	513
1897	57	1.4	.83	1.56	17.6	19.0	218.2	3.0	80.8	10.6	806
1902	62	1.8	.89	1.51	31.9	36.0	358.3	4.0	104.5	24.3	1091
1907	83	2.4	.84	1.58	44.1	58.2	569.8	5.0	141.6	39.6	649

* The Canadian Canal, opened in 1895, now carries 20 to 25 per cent of the total traffic.

XIII. CANADIAN LAKES TO SEABOARD CANALS

NAMES	LENGTH, MILES	LOCKS		PRISM, FEET
		No.	Dimensions, Ft.	
Sault Ste. Marie	1	1	900 × 60	150 × 141 × 20
Welland	26 $\frac{3}{4}$	27	270 × 45	160 × 100 × 14
Galops	7 $\frac{1}{8}$	3	800 × 45	144 × 80 × 14
Rapide Plat	3 $\frac{3}{8}$	2	270 × 45	152 × 80 × 14
Farrans Point	1	1	800 × 45	154 × 90 × 14
Cornwall	11	6	270 × 45	164 × 100 × 14
Soulanges	14	5	280 × 45	164 + 100 × 15
Lachine	8 $\frac{1}{2}$	5	270 × 45	Average 150 × 16
Total	73 $\frac{1}{4}$			

These dimensions should be compared with those of the Erie Canal given in Table II, *ante*.

XIV. PROGRESS OF WORK ON PANAMA CANAL TO JULY 1, 1908

DIVISIONS	EXCAVATIONS, BY FISCAL YEARS, IN CUBIC YARDS					
	1904	1905	1906	1907	1908	Totals
Culebra	243,472	914,254	2,702,991	9,177,130	7,087,338	20,125,185
Chagres	—	—	—	192,769	1,581,355	1,774,124
Colon	—	399,820	1,027,645	2,794,765	3,462,918	7,685,148
Gatun	—	—	26,628	1,340,179	1,834,704	3,201,511
Pacific	—	—	—	—	374,566	374,566
La Boca	—	485,153	1,191,233	2,143,789	3,770,676	7,590,851
Totals	243,472	1,799,227	4,948,497	15,648,632	18,111,557	40,751,385

The excavations made by the French companies are estimated at about 81,500,000 cubic yards; about one half thereof was rendered unavailable by subsequent submerging and filling up.

XV. EXPENDITURES ON ACCOUNT OF PANAMA CANAL, TO JULY 31, 1908

Purchase of French Company	\$40,000,000
Payment to Panama	10,000,000
Plant	\$31,679,877
Construction and Engineering	31,567,104
Sanitation	
Municipal Improvements	
Civil Administration	
Total	\$128,470,744

\$ 50,000,000

\$ 63,246,981

7,126,970

5,864,018

2,232,775

INDEX

Albany Regency, 30, 37, 50.
Appendix, 95.
Austria-Hungary, canals, 11.

Babylon, Great Canal of, 2.
Belgium, canals, 5, 6.
Bridgewater, Duke of, 9.

Canada, canals, 13, 70-73, 110.
 capacity, 72, 110.
 competition of, 70, 74, 76.
 cost of, 14.
 freight rates, 70.
 grain movement, 76, 107.

Chaldea, canals, 2.

Champlain Canal, New York, 27,
 29, 48, 60, 97, 99.

Charlemagne, 4.

Cheapening transportation, 15, 36,
 44, 62, 63, 75, 98, 103, 104.

China, canals, 2, 4, 14.

Civil War, United States, effect of,
 47.

Clinton, De Witt, 22, 23, 25-30, 34.

Clinton, George, 18, 19, 28.

Colden, Cadwallader, 16.

Colombia and Panama Canal, 80,
 81.

Commerce of United States and
 New York's share, 105, 106.

Competition against New York
 City, 67-87.

Competition of railways, 14. *See*
 also New York State canals.

Coöperation of land and water
 routes, 74, 77, 78.

Corinth Canal, 11.

De Lesseps, F., 80.

Denmark, canals, 10.

De Witt, Simeon, 24.

Differentials against New York
 City, 68.

Dutch as canal builders, 5, 6.

Egypt, canals, 2, 12.

Erie Canal, New York, beneficial
 influence of, 36, 40, 44, 61-64,
 67.

 breaking ground for, 28.

 capacity of, 27, 37, 42, 58, 60, 98.

 cost of, 33, 42, 99, 100.

 dimensions, actual and proposed,
 98.

 early projects, 20, 22, 25.

 earnings of, 48, 56, 99, 100, 103.

 enlargement projects, 37, 41, 58,
 60, 74, 98.

 estimates of cost, 25, 27, 99, 100.

 freight rates, 36, 40, 44, 53, 101.

 opening of, 30-33.

 profitable to State, 48, 56, 99, 100.

 regulator of freight rates, 63.

 tolls on, 40, 46, 101, 103.

 traffic, 101, 102.

 vessel tonnage, 37, 41, 42, 58, 98.

Federal aid for canals, United
 States, 24, 25, 92.

France, canals, 5, 7.

Freight rates, early, New York, 21,
 23.

 general, 36, 39, 40, 44, 45, 62, 70,
 75, 101, 104, 109.

French Panama Canal Co., 79-81.

Fulton, Robert, 23, 25.

Galveston, Texas, exports, 78.

Georgian Bay Canal project, 72.

Germany, canals, 7.

Government ownership, New York,
 64-66.

- Grain movement, United States and Canada, 76, 107.
- Great Britain, canals, 3, 9.
- Great Lakes, commerce of, 70, 109.
utilization for canals, 13, 17.
- Holland, canals, 6.
- India, canals, 12.
- Italy, canals, 11.
- Jefferson, Thomas, 23.
- Kiel Ship Canal, 8.
- Locks, invention of, 5.
- Madison, James, 25.
- Manchester Ship Canal, 9.
- Mingling of waters, Erie Canal, 31.
- Montreal, growth of grain trade, 76, 107.
- Morris, Gouverneur, 22, 25, 26, 31.
- Newlands, Senator F. G., on waterways, 90.
- New York City, commerce of, 68, 105, 106.
competition against, 67-87.
port charges, 69.
railway discrimination, 68, 74.
- New York State canals, 16-78, 97-104.
abandoned works, 52, 97, 100.
abolition of tolls, 54, 57.
boards and commissions, 25, 26, 27, 44, 52.
canal debt, 26, 27, 40, 41, 42, 43, 55, 59, 108.
"canal ring," 38, 50, 51.
competition of railways, 38, 45, 46, 53, 61, 104.
constitutional provisions, 40, 47, 51, 52, 54.
construction data, 97.
cost of, 35, 41, 42, 48, 56, 99, 100.
decline of, 54, 57.
early plans and surveys, 16-20, 25, 27.
- earnings, 33, 35, 39, 42, 44, 53, 54, 56, 99, 100, 103.
efforts to improve, 58, 60.
enlargements, 37, 41, 42, 59, 98.
slow progress of, 37, 75.
equipment of, compared with railways, 48.
extravagance and waste, 37, 50, 51.
financial statements of, 40, 42, 48, 56, 99, 100.
freight rates, 21, 23, 36, 44, 45, 53, 61, 63, 101, 103.
estimated reduction of, 75, 98.
imperative need of improvement, 58, 73.
influence on growth of State, 57, 64, 108.
neglect of, 49, 55, 64, 66, 70, 77.
operating cost, 44, 46, 51, 103.
opposition to, 22, 38, 49, 55, 59, 77.
patronage, 28, 29, 37.
political influences, 29, 38, 50.
revenue. *See* Earnings.
sale of, prohibited, 40, 52.
superintendent of works, 52.
tolls, 39, 44, 45, 46, 53, 101, 103.
abolished, 54.
traffic, 25, 39, 43, 45, 53, 56, 57, 61, 101, 102, 104.
vessel tonnage, 37, 41, 42, 60, 74, 98, 104.
- New York State, debt of, 55, 108.
growth of, 57, 108.
inefficient canal policy, 49, 55, 58, 64, 66, 77.
railway subsidies, 39.
valuation of property, 108.
- Panama Canal, 79-87.
Colombia and Panama, 80, 81.
estimates of cost and work, 82, 83, 111.
tonnage and revenue, 85.
expense of, 83, 111.
importance of, 84, 86.
progress of work, 83, 111.
- Public ownership of utilities, 64-66.
- Puget Sound, exports, 78.

- Railway competition, 14. *See also*
New York State canals.
- Railways, inadequate service of, 73,
74, 88.
- Religious scruples against canals,
12, 79.
- Roman canals, 3.
- Russia, canals, 10.
- St. Lawrence route, 70, 71.
- Sault Ste. Marie (St. Mary's Falls)
canals, 13, 71, 109.
traffic on, 109.
- Spain, canals, 11.
- State sovereignty question, United
States, 26, 92.
- Statistical tables, 97-111.
- Suez Canal, 3, 12.
- Sweden, canals, 11.
- Tammany, New York, opposed to
canals, 22.
- Tilden, Samuel J., 50.
- Tompkins, D. D., 27, 29, 33.
- Ton mileage, New York, canals and
railways, 104.
- Ton-mile cost freight, 98, 109.
- United States, canals, 13, 14.
imperative need of, 16, 17.
- Washington, George, 17, 18.
- Waterways of world, 14.
- Waterways question, 88-93.
- Welland Canal, 14, 70.
- World's canals, 1-15.
mileage and cost, 14.

Carnegie Institute of Technology
Library
PITTSBURGH, PA.

UNIVERSAL
LIBRARY



138 113

UNIVERSAL
LIBRARY